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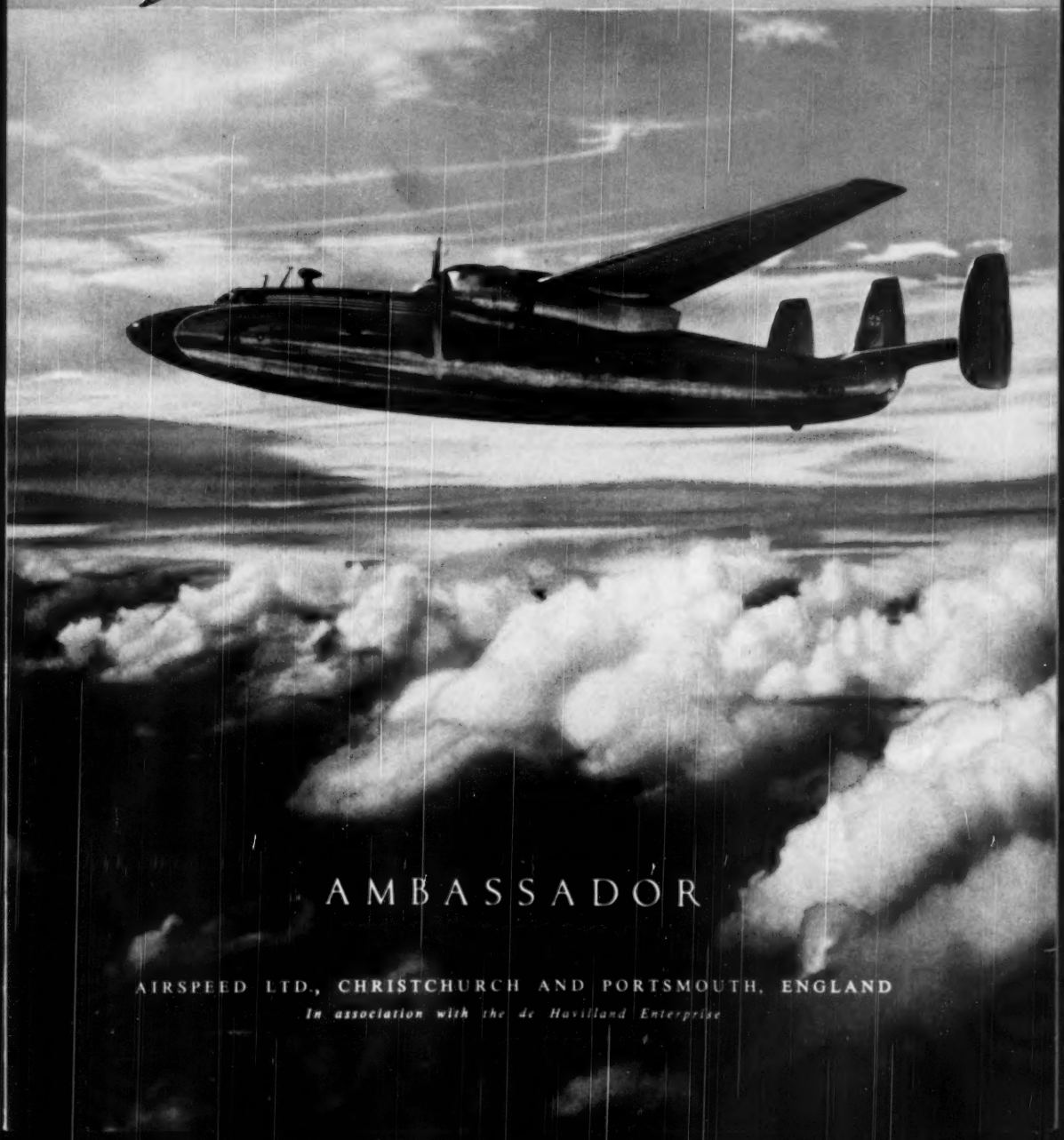

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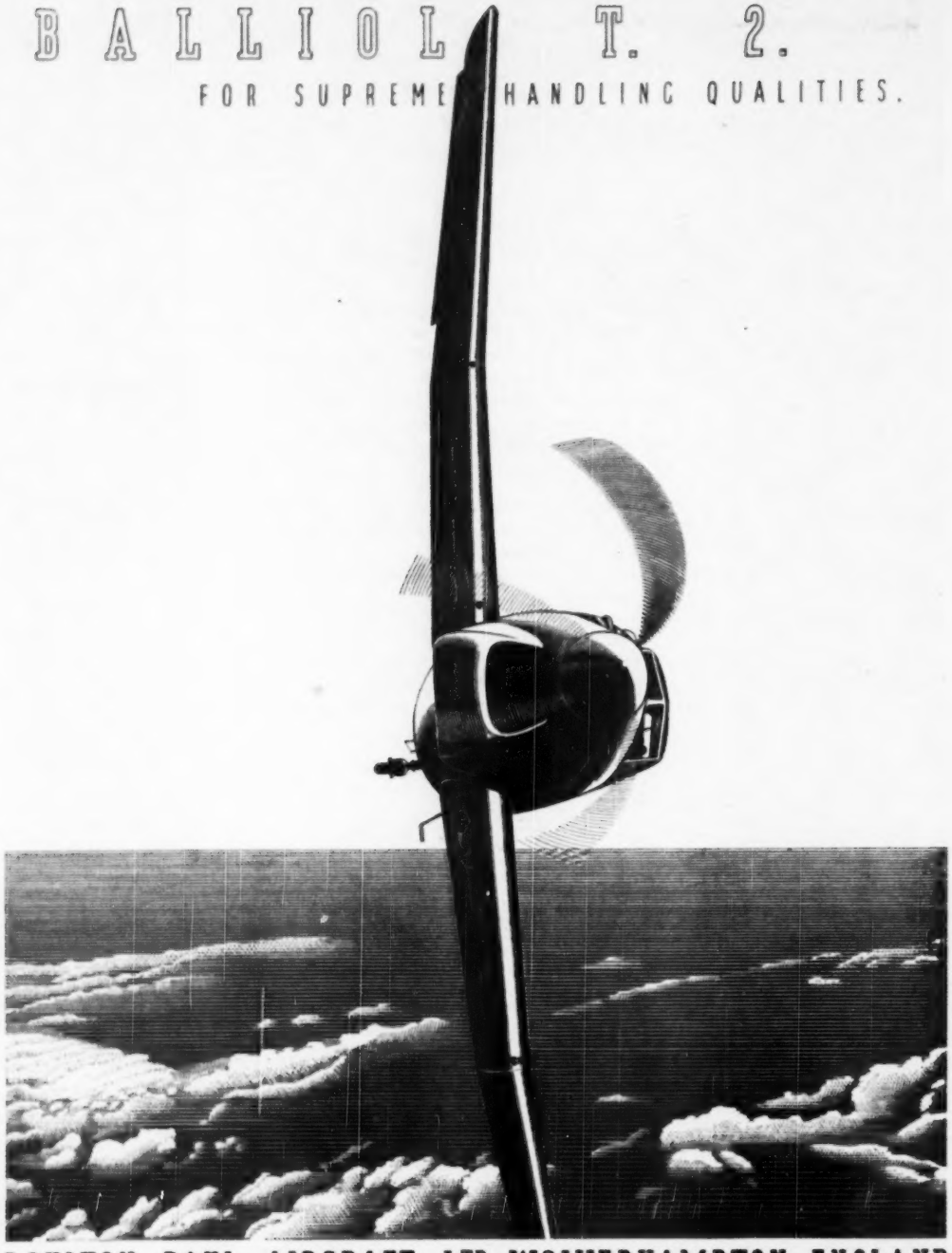

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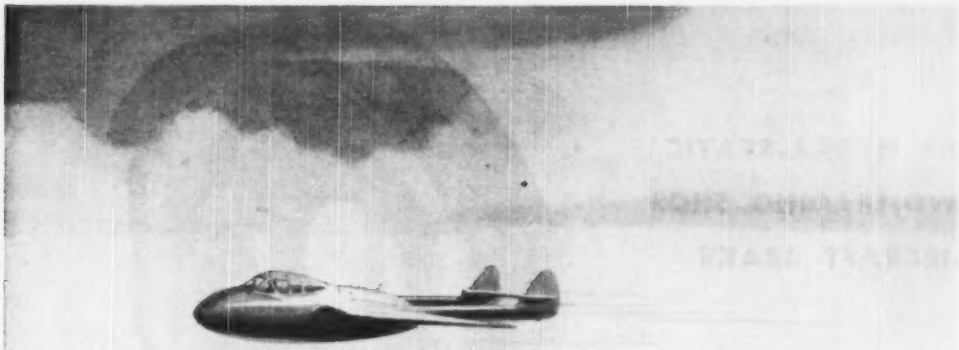

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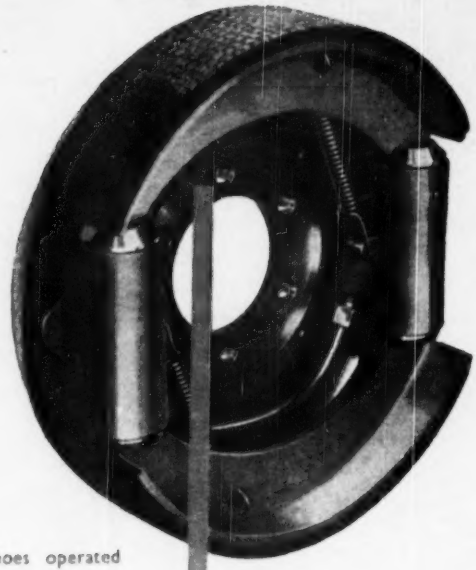

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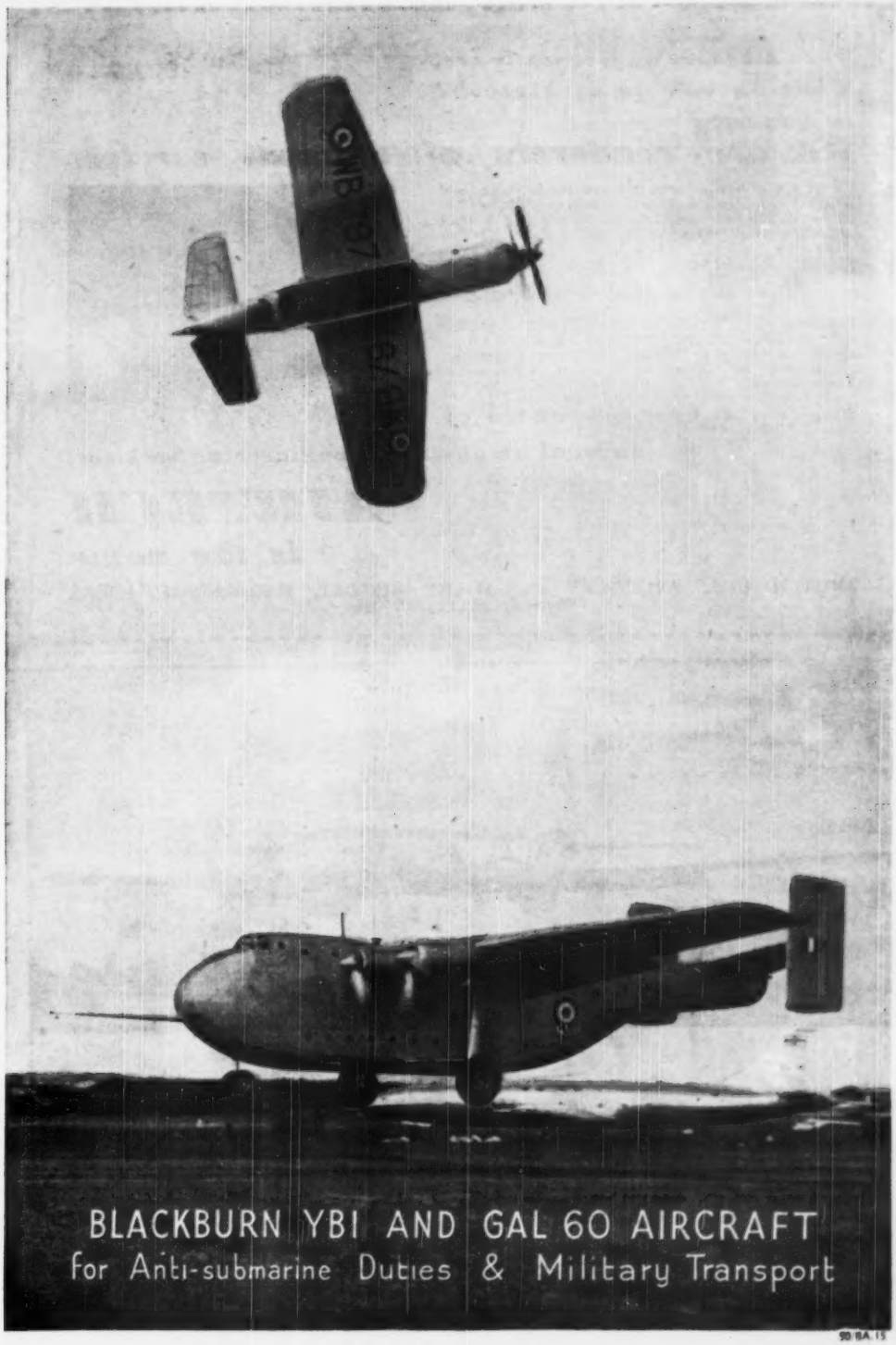
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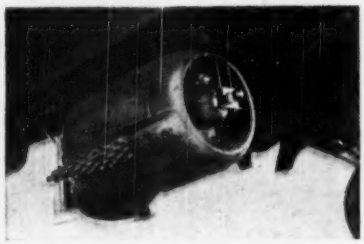

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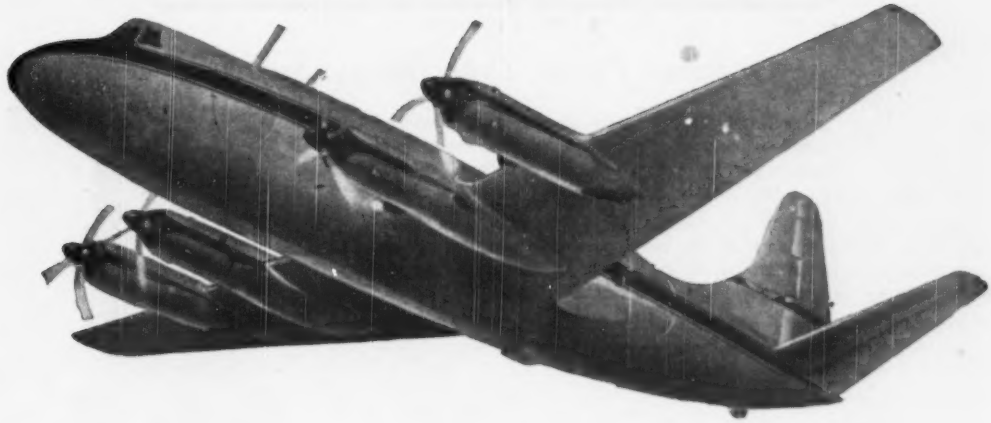

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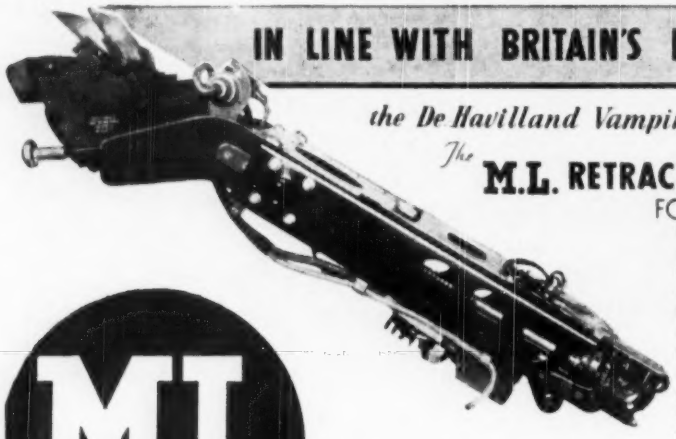

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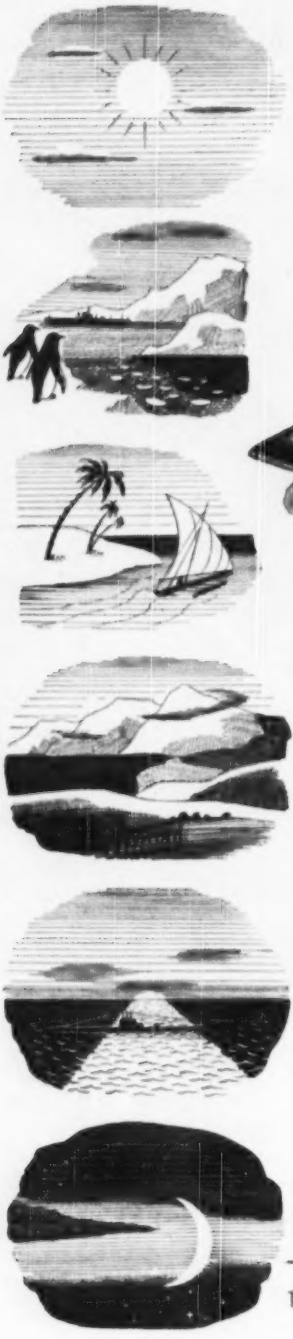

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In this issue:

Westland's New Acquisition - - - 448
For Fleet Defence - - 450
Selachian Selection - - 454
Global Classroom - - - 456
Fighter Armament 459
Vampire Trainer - - - - 462
Economical De-icing - 468

First Catch Your Hare . . .

A FEAR expressed in this column only two weeks ago—that American Shooting Stars might find themselves at a serious disadvantage if matched against the fastest Soviet fighters—appears, on the face of recent reports, to have been well founded. A Shooting Star pilot avers that a Communist jet which he engaged (and —all praise to him—shot down) proved 100 m.p.h. faster than his own machine. Though the daily Press has, perhaps, made undue play with somewhat scant and garbled accounts of jet *v.* jet engagements, it is reassuring to learn that faster fighters than the Shooting Star (probably 670-m.p.h. Sabres) are to be despatched to Korea.

More comforting, to British ears at least, would be news that faster types of fighter will be introduced into the Royal Air Force in the not-too-distant future. There is no concealing the fact that, although standard R.A.F. fighters possess certain vital qualities in a pre-eminent degree, their development for speeds of the present world-record order is not possible or has not been undertaken. (In this connection, it is not generally known that a "swept" version of the Meteor—the Mk. 6—was at one time projected, but, doubtless for compelling reasons, was never constructed). The Venom—probably the supreme example of the high-altitude fighter—for which orders have already been placed, is assuredly much faster than its precursor, the Vampire; but the Venom is unlikely to equal the speeds attained by new British, Russian and American types possessing the aerodynamic advantage of sharp sweep-back.

Although the statement has been made on behalf of the Hawker Company that the P.1081 "will be built in this country" (implying production), there is no official confirmation that the type will ever see R.A.F. service; nor is there any reason to suppose that the Supermarine 535, of comparable performance, has been adopted by the Air Ministry. The inference is that even faster, and generally more formidable, types—not yet in being—are intended for the future equipment of R.A.F. fighter squadrons. But even if orders have already been placed "off the drawing-board," a lengthy period must ensue before the R.A.F. can be equipped with British-built fighters as fast as America's or Russia's best.

While it is recognized that speed is only one desirable quality in a fighter, those responsible for formulating operational requirements must ever be mindful of the ancient exhortation which heads these words.

Technological Expansion

THE productive capacity of this country is fairly readily capable of expansion to meet in some large measure an emergency. In this regard, the lessons and experiences of 1939 to 1945 are a valuable legacy. But whereas productive capacity is broadly a material matter of factories and machine tools, and the employment of *ad hoc* semi-skilled labour, the supply of technicians to match the demand is likely to prove a very real problem.

It is symptomatic that the advance of technical progress is of permanently increasing difficulty—not so much in the fields of pure or basic research as in those of applied science. The measure of this is implicit in the degree of specialization now forced upon technicians. If the young technician is to do the best for himself and his industry, it is essential that his specialization should start early: but "there is an urgent need for a wide development of technological education in this country, if Great Britain is to maintain its place as a leading industrial nation." This quotation is from the recently issued first report of the National Advisory Council on Education for Industry and Commerce. That the situation is the more imperative if this country is to meet the possibility of a world emergency does not need emphasis.

Necessarily, the higher standards of technical education can be achieved only by many years of study, but it is at least encouraging to note that the problem is receiving high-level attention. It only remains to hope that the translation of ideas into reality will not be too long delayed.

Manufacturing Rights for the Sikorsky S.55 Secured on a Private-venture Basis : Power-unit Problems

A flight-impression of an S.55 carrying Service roundels. Note the four-wheel landing gear.

WESTLAND'S NEW ACQUISITION

A FEW weeks ago, in a leading article, *Flight* discussed helicopters and their power units, reference being made in particular to the promise for the future shown by jet-driven rotor systems. In the meantime, the Westland Aircraft Co., Ltd., of Yeovil, have announced an extension of their licensing agreement with the Sikorsky company of America and the commencement of manufacture of the ten-passenger S.55, adding that the absence of a suitable British engine makes it necessary for the time being to fit 600 h.p. Pratt and Whitney Wasps.

It takes but a few seconds to make a mental check of British power-unit possibilities; the only single unit approaching the requirements is the Alvis 520/570 h.p. Leonides as fitted in the earlier S.51. This engine, however, is in a slightly lower power class. Paired units offer certain possibilities, and at the same time help to meet the widely held view that all commercial helicopters operating into towns and cities should have two engines. To pair units takes time and money, however, and weight quickly becomes prohibitive. For example, the weight/take-off-power ratio of the Leonides engine is about 1.30 lb/h.p., and of the 600 h.p. P. and W. Wasp 1.44 lb. Of the 1,600 h.p. R.R. Merlin it is only 0.91 lb. On the other hand, two D.H. Gipsy Queen 70s, together giving 700 h.p., would show a ratio of about 2 lb/h.p., and two Cirrus Grenadiers of 620 h.p. total around 1.77 lb/h.p. As has been mentioned on a previous occasion, some authorities believe that practically insoluble gearing problems are likely to be encountered in the event of gas turbines being used to drive rotors mechanically.

Reverting to the particular case of the Westland S.55, to be built as a private venture but with good prospects of military orders, either Wasps must continue to be fitted, the Alvis company must evolve a more powerful version of the already well-developed Leonides, or, conceivably, a unit such as the old Bristol Mercury or sleeve-valve Aquila might be rejuvenated. The civil Aquila IV was giving 600 h.p. in 1939, and at the same time the Mercury IX gave 830 h.p. for a weight of 1,000 lb.

Details of the S.55

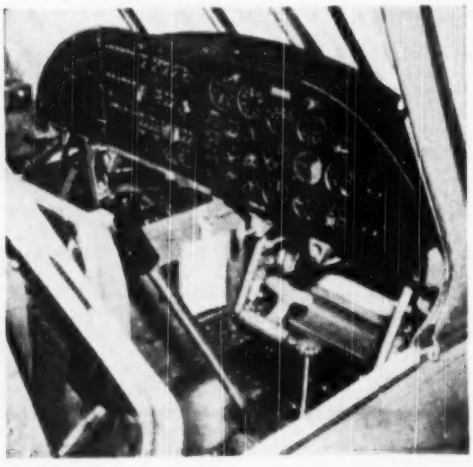
A considerable amount of new information about the S.55 has been released, of which a digest follows. Additionally, the layouts of the three alternative versions are illustrated. These three arrangements enable the S.55 to undertake normal commercial duties such as the carriage of passengers, air mail and freight; civil or military rescue and ambulance work; and all normal communications, spotting and transport duties for the Services. It could also be adapted to carry depth charges or bombs.

Because the passenger cabin is located directly under the main rotor, load may be added or removed without appreciably affecting the c.g. of the aircraft. The dimensions of the cabin are 10ft long, 5ft 6in wide and 6ft high, and the total available space is 340 cu ft. The two-seat pilots' compartment, containing dual controls, is forward of and above the main cabin and may be entered either from outside or from the cabin.

In the ambulance version illustrated, six stretchers in banks of three are indicated. All these can be loaded by the power-operated hoists installed near the pilot's window, and a further two stretchers can be on-loaded by hand. Hoisting operations are easily observed and supervised from the pilot's window, and it will be noted also that there is good rearward vision from the cockpit.

Contrary to fixed-wing practice, the first pilot normally flies from the starboard side. Instruments are provided for night and day flying, and panel grouping is in accordance with advice from numerous pilots. Red cockpit-lighting is provided for night flying, and the landing lamps are behind and below the cabin. Apart from their primary purpose, the lamps are controllable independently by pilot or co-pilot, and may thus be used for search and rescue operations.

By comparison with the S.51, the four-wheel landing gear gives improved stability for take-off and landing as well as during ground handling. The two nosewheels are fully castering and self-centreing. Reference was made last week to the availability of amphibious landing gear, with which successful tests have been carried out.



A neat pilot-chosen cockpit layout is coupled with good all-round vision.

It is apparent that the structure of the S.55 has been kept as simple as possible, always with an eye on accessibility and ease of maintenance. Double curvatures and complex structures have been reduced to a minimum, and a good example of accessibility is the enclosure of the nose-mounted engine within two non-structural doors. Gear box, clutch, transmissions and controls are all accessible by the removal of panels, and for example, the fan assembly can be withdrawn through a large door in the fireproof wall of the forward cabin. Access to the main transmission is from the pilots' compartment, and in this instance the removable panels are soundproof.

For overhaul, the main rotor head, transmission with accessories and complete hydraulic-servo-control system can, it is claimed, be removed and replaced within three hours. Additionally, every main component can be changed within 15 man-hours. In the supporting structure for the tail cone behind the cabin are the heating and ventilation systems and some baggage space. This compartment is accessible from the outside as well as from the cabin.

Interchangeability with the S.51

A considerable number of the components of the S.55 are basically the same as those in the S.51, and many individual items are interchangeable. However, the new-type main rotor head is simpler in design, and, it is said, affords more immediate control response and greater stability and manœuvrability, in addition to an increased centre of gravity travel. Control is by a straightforward mechanical push/pull system in which friction and vibration are practically eliminated by a servo booster. In the event of an hydraulic failure complete mechanical control remains. The rudder pedals, adjustable in reach, carry individual toe-brakes.

An aerofoil surface similar in action to the trim tabs of fixed-wing aircraft and controlled by the pilot from the cockpit, is located behind the tail cone. It helps to maintain the optimum attitude for the aircraft and gives increased stability.

Both main and tail rotor blades are all-metal and should thus need little or no maintenance. The blades in each rotor are interchangeable and those of the main rotor fold for storage or transport.

Normal fuel capacity is 150 Imp. gall, sufficient for 400 miles, but for ferrying purposes additional tanks can be fitted which bring the range up to nearly 1,000 miles.

In the American military version of the S.55 the Wasp S.1.H2 is fitted to increase performance at the higher altitudes. It gives a ceiling improvement of 3,000ft (915 m) as a result of the higher degree of supercharging provided.

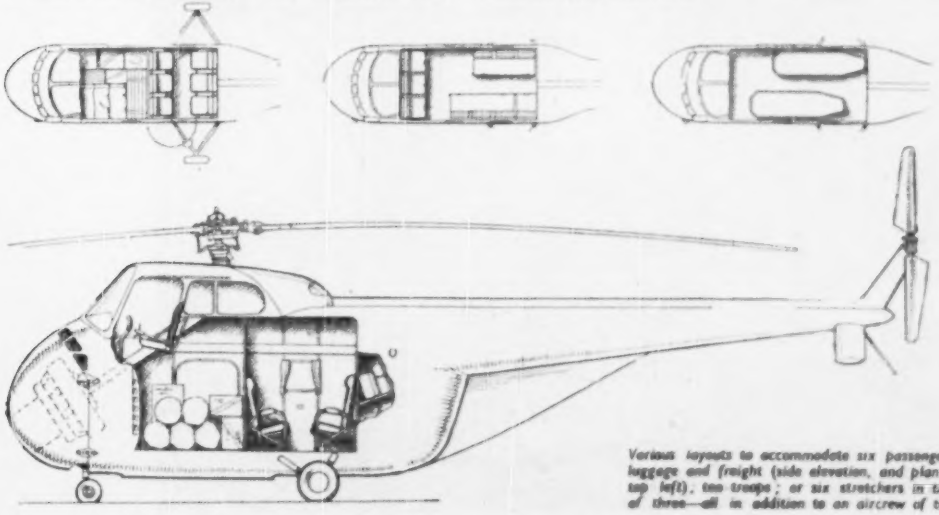
Details of the rotor head and power hoist may be seen in this photograph.

WESTLAND-SIKORSKY S.55

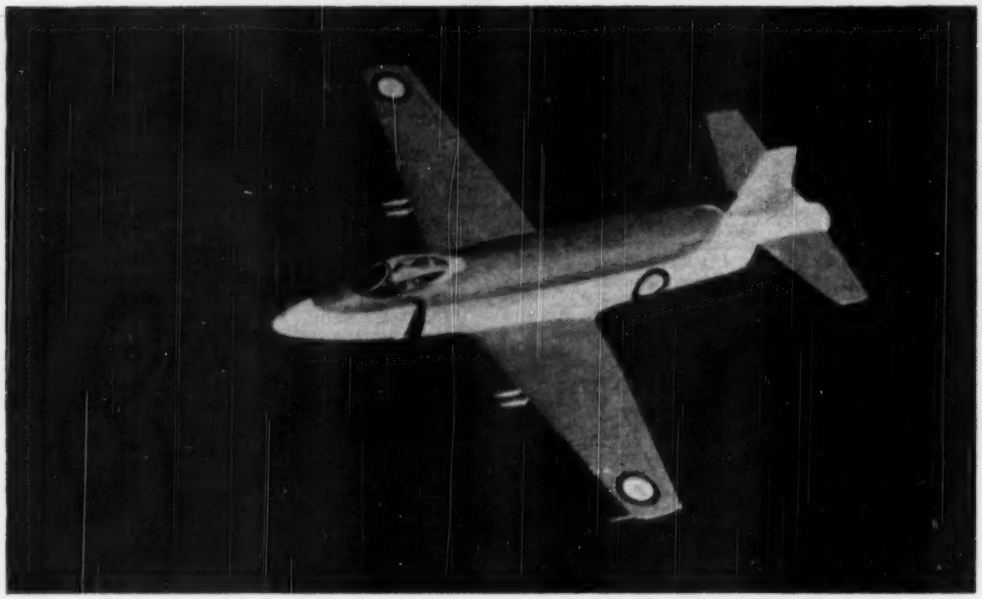
(600 h.p. Pratt and Whitney Wasp *R.1340 S.1H2*)

High speed at sea level	110 m.p.h.	(177 km/hr)
Cruising speed at 70 per cent b.h.p. at 1,000ft (305 m)	86 m.p.h.	(138 km/hr)
Max rate of climb at sea level	1,130 ft/min	(5.7 m/sec)
Vertical rate of climb at sea level	350 ft/min	(1.8 m/sec)
Hovering ceiling with ground effect	5,500ft	(1,680 m)
Hovering ceiling without ground effect	4,200ft	(1,280 m)
Service ceiling	13,500ft	(4,120 m)
Fuel consumption (cruising)	30 gal/hr	(136.4 litres/hr)
Range (with reserve)	477 miles	(770 km)
Gross weight	6,800 lb	(3,089 kg)
Useful load	2,405 lb	(1,092 kg)
Weight empty	4,395 lb	(1,997 kg)
Fuselage length	41ft 6¾in	(12.70 m)
Fuselage width	5ft 11in	(1.80 m)
Height overall	14ft 8in	(4.46 m)
Main rotor diameter (blade tip circle)	53ft	(16.10 m)
Tail rotor diameter (blade-tip circle)	8ft 8in	(2.64 m)
Main landing gear tread	11ft	(3.35 m)

The empty weight quoted above refers to the utility cabin interior with ten troop-type seats, basic soundproofing and radio equipment. The executive layout with six seats involves a weight increase of approximately 175 lb. Weights of other items of optional equipment are: cabin heater and defroster, 66 lb; all-metal amphibious landing-gear, 305 lb; power-operated hoist, 54 lb; F-4A attitude gyro, C-2 gyrosyn compass, and landing lights—11 for night and blind flying—46 lb; double-capacity (200 amp) generator, 10 lb.



Various layouts to accommodate six passengers, luggage and freight (side elevation, and plan at top left), ten troops; or six stretchers in tiers of three—all in addition to an aircrew of two.



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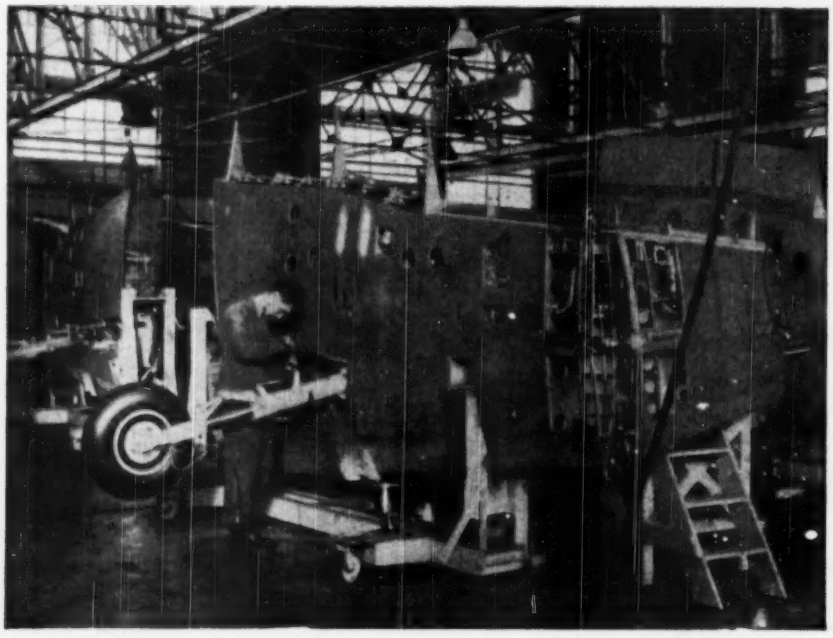
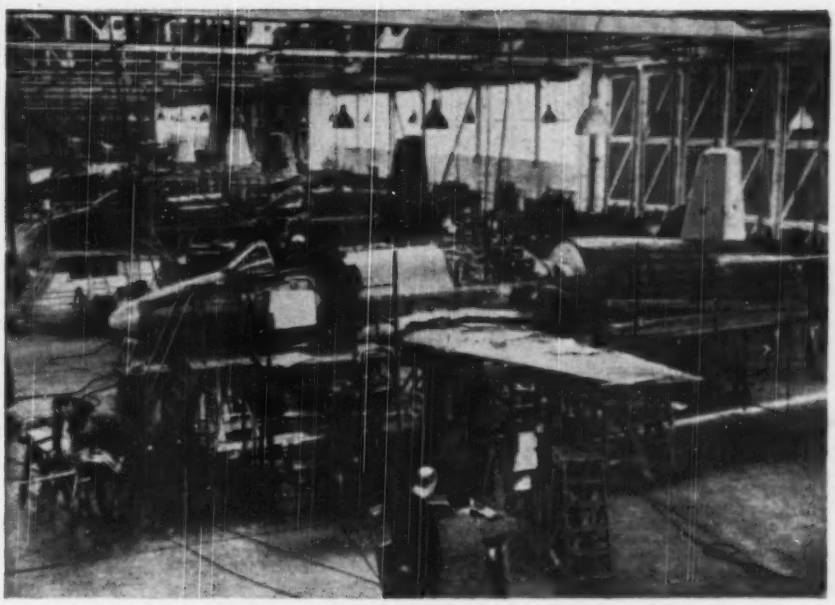
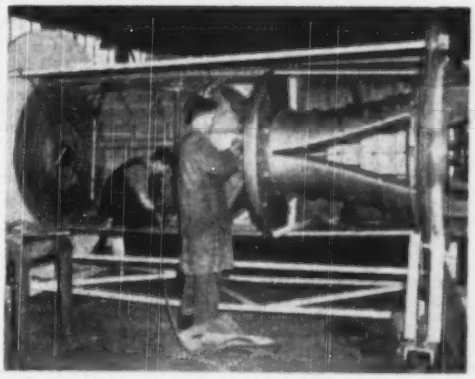
Flight and Production-line Studies of the Attacker Deck-landing Intercepter

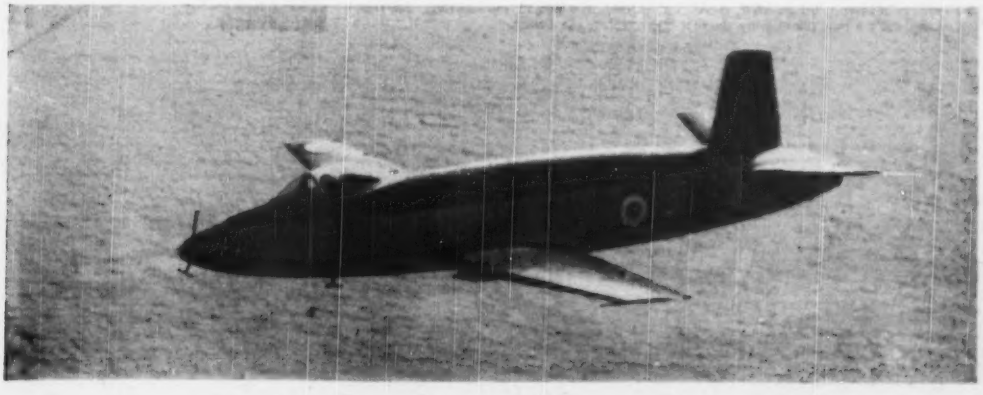




CAPABLE of a Mach number of 0.825, armed with four 20-mm British Hispano Mk. 5 guns, and—with its 250-gallon ventral tank—having an ultimate range of nearly 1,200 miles, the Vickers-Supermarine Attacker F.Mk.1 deck-landing intercepter is assured of a welcome when it passes into squadron service with the Royal Navy early in the new year. The recent flight studies on these two pages illustrate the Attacker's remarkably clean and wholly attractive lines, and those showing phases of production reveal certain characteristic design features.



Heading this page is a close-up of an Attacker on the production line. The view is especially revealing in that the midships installation of the Rolls-Royce Nene turbojet, of 5,000 lb static thrust, is exposed. Although installation of an afterburner is feasible, aircraft of the initial batch do not incorporate this feature. On the right, work is in progress on the power-plant bay; the ducts leading from the laterally disposed intakes are of D-section. At lower left is an almost complete wing, with the tip portion in the folded position. Various attachment and inspection points are visible, as are the case and link chutes for the guns. The long-stroke undercarriage legs are of nre-retracting type.



HERE and THERE

Canberra Production . . .

THERE has been much good news about the English Electric Canberra during the last week. Production is to be greatly stepped-up with the aid of the A. V. Roe, Handley Page and Short Brothers and Harland companies. English Electric, which has already commenced production, is also reported to be taking over an extensive factory near Blackburn in connection with Canberra manufacture.

. . . American Interest

ACCORDING to *Aviation Week* of America the Canberra is a "dark horse with bright performance" in the eyes of American Air Force senior officers at the Pentagon, and it seems that it is an odds-on favourite in the competition for a new aircraft for light-bomber/troop-support duties. A fair-sized order might be given for the Canberra, and the number would be made up with another order for one of the three American types in the running: the three-jet Martin XB-51, the earlier four-jet North American B-45 and the slower piston engine-cum-jet AJ-1 produced by the same company.

It is rumoured that a Canberra is shortly going to America for tests by U.S.A.F. pilots.

Far East Assignment

ON Tuesday last the Art Editor of *Flight*, John Yoxall, left Lyneham in an aircraft of Transport Command for a visit to R.A.F. and R.A.F. Regiment units in the Far East. The trip will take three to four weeks, of which eight days will be taken up by travelling to and from Singapore. In addition to seeing the units operating against the bandits in Malaya he hopes to go on to Hong Kong and Japan.

UNLOADING: Paratroops tumble from Fairchild C-119 Packets during a recent landing in North Korea. Jumping in quick succession through the open rear fuselage of the aircraft, they land in a close group in the dropping zone. The Packets' high angle of incidence is noteworthy.

Festival Helicopter Service?

IT is learned that plans have been made and licences have been applied for in connection with a helicopter service to be run between Paris, Le Touquet and London during the Festival of Britain. Ten Hiller helicopters are likely to be used, eight being in daily service. A 48-hour visit to London and the Festival for dollar passengers is the aim. Many approvals will be needed—from the Board of Trade, M.C.A., B.E.A. and so on—but as a start the A.R.B. is prepared to recognize the American certification of the aircraft for carriage of passengers.

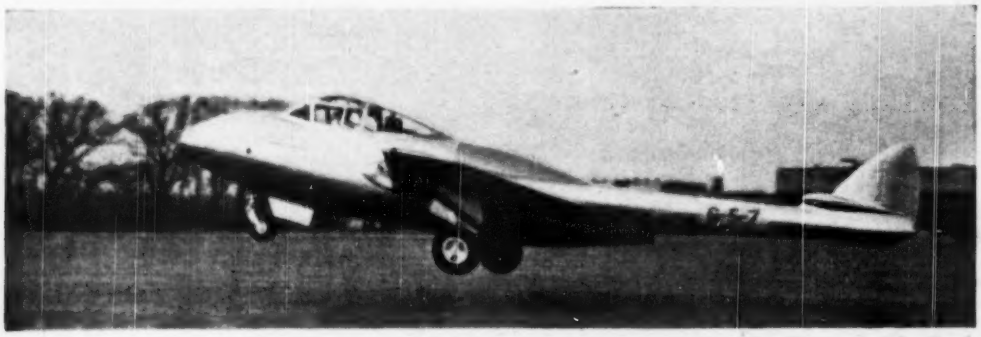
Helicopter Lecture

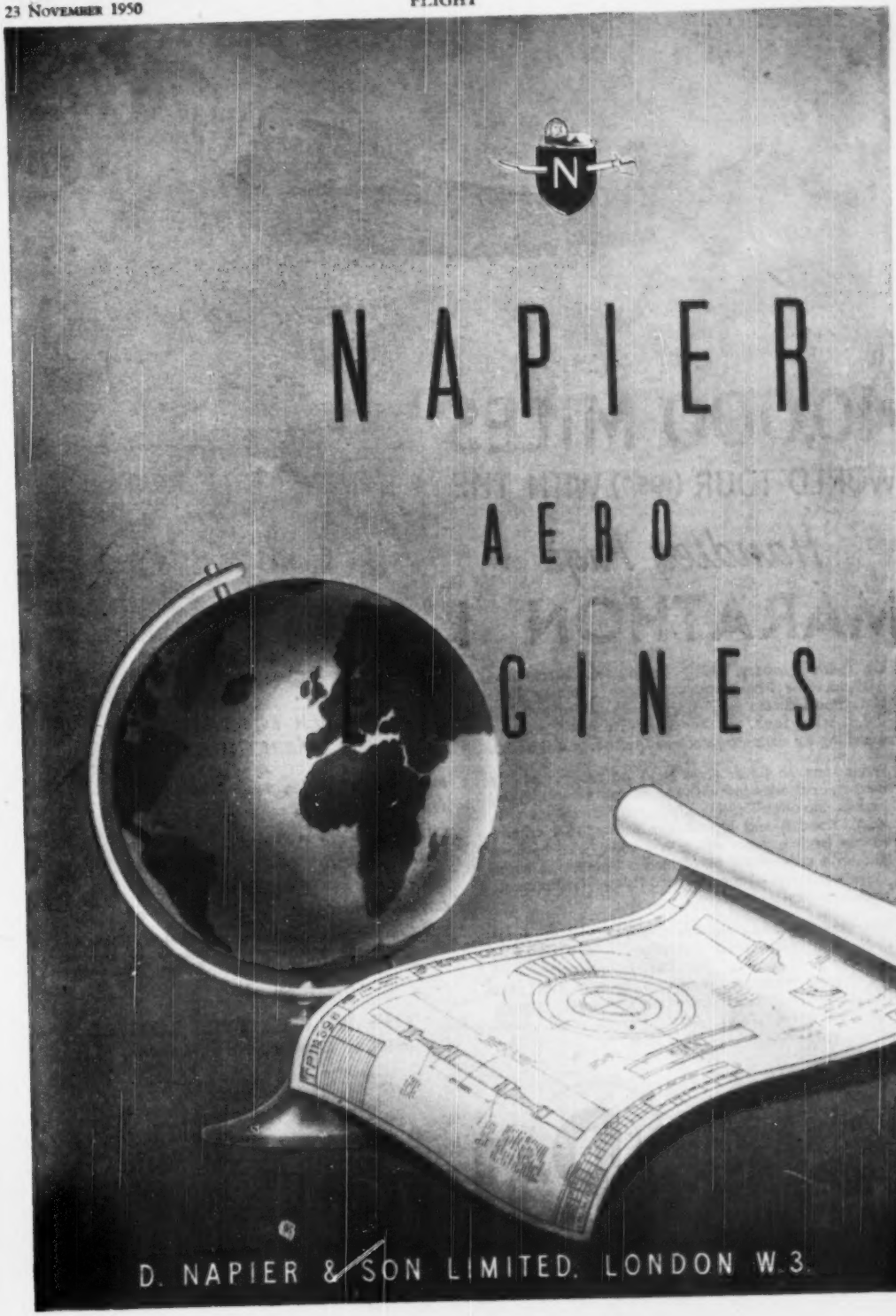
ON Saturday, November 25th, Capt. J. S. Fay, of the B.E.A. Helicopter Unit, is to read before the Helicopter Association a paper entitled *Some Present and Future Aspects of Helicopter Piloting*. Capt. Fry has concerned himself with the problems of flying helicopters, the good and the bad points, the desirable and the undesirable. His lecture should prove most valuable.

Light Aircraft in Antarctica

AT the Royal United Service Institution in London on November 15th, S/L. G. B. Walford showed an excellent colour film taken during the British-Scandinavian Expedition to Queen Maud Land, when a flight of two R.A.F. Mk. 6 Austers was successfully employed as a reconnaissance unit to the *Norsel* (see *Flight*, March 30th, 1950). The film was

MAIDEN TAKE-OFF: The prototype Vampire Trainer is seen taking off from Christchurch airfield last week on its first flight. During this 25-minute test, two check landings were made on the runways at Hurn. On the right is Mr. John Wilson, who was at the controls. He was John Cunningham's second pilot during the first flight trials of the Comet.

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40,000 MILES
WORLD TOUR (1950) WITH THE
Handley Page
MARATHON I

On 14th January, 1950, from the Blackbushe Airfield, the first production-type Handley Page Marathon I Aircraft (G-ALUB) took off for a 40,000 miles sales tour to the Southern Hemisphere—equalling an airline operational period of 600 hours.

From start to finish (2nd May) no trouble of any kind was experienced with the Palmer wheels, tyres, brakes, Silvoflex flexible pipes, etc. The pilot (Mr. Hugh Kendal) and his officers paid special tribute to the landing gear, which was considered to have put up a spectacular performance because so much more was asked of the standard Palmer Components than is normally expected.

250 landings and take-offs were made at aerodromes in temperature extremes of 30°F (Bagdad) and 110°F (Calcutta). The amazing performance of the Palmer tyres is evidenced by the fact that the runway surfaces included concrete, tarmac, bitumen, steel plates, coral, asphalt, turf, oiled strips, sand, etc.

PALMER EQUIPMENT ON MARATHON I

Main Wheels, Tyres and Brake Assemblies (4)

Nose Wheel and Tyre

C.11 Pneumatic Rams (4)

706.B Brake Control Units (2)

C.43 Pneumatic Control Unit

C.25 Nose Wheel Ram

Silvoflex (fireproof) flexible hose assemblies in the fuel, oil, pneumatic and Graviner systems of the four de Havilland 'Gipsy-Queen' Series 70.2 engines.

THE PALMER TYRE LIMITED
Penfold St., Edgware Road, London, N.W.8.

Palmer
TYRES · WHEELS · BRAKES · SILVOFLEX

taken by the flight's second-in-command, F/L. H. M. T. Tudor, D.F.C. In an informal lecture on the film, S/L. Walford said that the use of light aircraft in such ventures was well worth while provided that their shortcomings (e.g., their vulnerability on shipboard, and their inability to operate in thick weather) were borne in mind. They could "more than earn their keep" if used for local visual reconnaissance to assist the ship to find her way through pack ice; for local photo-reconnaissance; for search and rescue; and for supply-reinforcement of sledging parties. He discounted their use for actual exploration, surveys and mapping.

Paris Show Date

THE Paris Show will be held next year from June 15th to July 1st. Small aircraft, engines and ancillary equipment will be exhibited in the Grand Palais and an international flying display will be staged at Le Bourget.

Guns for Dutch Meteors

THE Hispano-Suiza Company is to open a factory in Holland to produce guns (presumably of the standard 20 mm pattern) for Meteors built under licence for Holland and Belgium by the Fokker Works. The new factory, which will employ 500 workers, is not expected to be in full production before 1952.

Score of Bulls

CLAIMED to be a record weight-lift of live cattle, 20 bulls were recently transported in one flight by a Bristol Freighter of A.N.A. over a distance of 100 miles in Northern Australia. The whole operation of loading, flight and unloading took only two hours, as against three weeks for driving the animals overland. The cost worked out at 30s a head, the bulls being carried as a "backload."

Unanimous Opinion

NORTH Korean prisoners have confirmed the U.S.A.F. evalution of the Lockheed F-80 Shooting Star as "a superb weapon for close support." A recent statement by Lt. Gen. Stratemeyer, American Far East Air Force commander, revealed that "More than 2,000 Communist prisoners, from colonel to private, have been interviewed and the sifting of these reports produced one inescapable conclusion: our jet fighter is the most effective and the most feared weapon we have employed against the North Korean military machine."

FIRST AND LAST: Still flying from the Fairey Company's airfield at White Waltham, this is the prototype Fulmar (R.R. Merlin 30)—the first Naval eight-gun fighter, developed from a 1934 specification. It has been modified to carry three people (instead of two) and is thought to be the only surviving example of 602 Fulmars built.

Siam Survey

THE Government of Siam has awarded to Hunting Aerosurveys, Ltd., a contract, put out to international tender, for aerial photography and mapping of some 15,000 sq km in Central Siam. In addition, a large-scale survey for a new railway has been ordered. A Percival Survey Prince is being used for the operation; already on its way to Bangkok, it is equipped with a Smith's S.E.P.1 autopilot monitored by a Hughes G.3 magnetic gyro compass. Two Williamson Eagle IX electrically controlled survey cameras are being carried.

The expedition manager is Capt. J. H. Saffery, D.S.O., chief pilot of the company, and included in his crew is Mr. J. S. English, chief photographer.

NEWS IN BRIEF

MR. G. R. SHAW, until recently engineering manager at the B.O.A.C. flying-boat base at Poole, is joining Pest Control, Ltd., Bourn, Cambridge, as general manager.

* * *

The Avro Ashton high-altitude research jet aircraft, demonstrated for the first time at Farnborough Exhibition, has been equipped with the Sperry Gyrosyn Compass Type C.L.2.

* * *

Unique among industrial directories published to promote Britain's export trade, in that it shows a substantial cross-section of the most important producers of British goods, is the *F.B.I. Register of British Manufacturers*, 1950-51. Published at 42s by Kelly's Directories, Ltd., in conjunction with Iliffe and Sons Ltd., it comprises 852 pages (9¼in × 7¼in) of information.

Flameproof relays and automatic switchgear for industrial and research applications are illustrated in a leaflet from Londex, Ltd., 207, Anerley Road, London, S.E.20.

* * *

From an American firm of consulting engineers, Amman and Whitney, 611 N. Broadway, Milwaukee, Wisconsin, comes a brochure entitled *Cast of Long-span Concrete Shell Roofs*. Illustrated is a hangar, for American Airlines, with two 257-ft spans.

* * *

To the list of contributors of aeronautical articles in the *Britannica Book of the Year*, 1950, (reviewed in *Flight* of November 9th) should be added the name of G. D. H. Linton, formerly Press Officer at London Airport: he is responsible for the sections on European airports and on air races and records.

* * *

Before Maj. P. L. Teed's recent R.Ae.S. lecture at Belfast (see p. 428 of *Flight* last week) a special prize awarded by the Society for the best work by a student of the Belfast College of Technology was presented by Major G. P. Bulman, C.B.E., Director of Construction and Research Facilities, Ministry of Supply, and president of the R.Ae.S. The recipient was W. J. Hanlon.

* * *

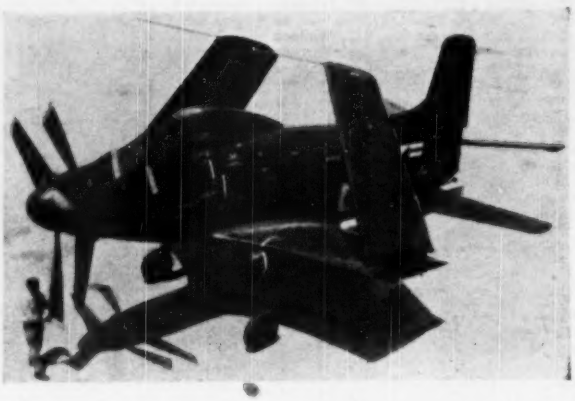
Claimed to be the first of its kind in this country, new high-speed machinery has been installed—at a cost approaching £20,000—in an extension to the Holmfirth, Yorks., mills of T. and J. Tinker, Ltd. Its purpose is the preparation of yarns from which the firm's Tinkertex fireproof and mothproof fabrics are made. Specially suitable for aircraft upholstery and curtaining, these materials are, it is stated, the subject of large orders received during and since the S.B.A.C. Show, at which the makers exhibited.

FOR EXPORT: This Bristol Fighter has flown to Sydney—by B.O.A.C. and Qantas. A model replica of the aircraft used during the 1917 Allenby campaign by Capt. Ross Smith, it was made by Rolls-Royce, Ltd., and presented to the Australian War Museum, Canberra.

SELACHIAN SELECTION

The Douglas XA2D-1 Skyshark :

PART II : Design and Performance



This view of the Skyshark with wings folded accentuates the dimensions of the Aeroproducts counter-rotating airscrews ; they absorb 5,500 h.p.

By STANLEY H. EVANS, F.R.Ae.S., A.F.I.Ae.S.

LAST week Stanley H. Evans described the general layout of the Douglas Skyshark (Allison T-40 dual turboprop) and its development from the Skyraider family. In this continuation he discusses certain aspects of stability and control suggested by the design, and makes some performance estimates. The word "selachian," incidentally, means "belonging to an order of fishes represented by the sharks and rays."

BECAUSE, in the nature of nautical things, the stability and control requirements for carrier-borne aircraft must be unusually severe, considerable research and development have gone into this side of design, some of which can be diagnosed from a study of the Skyshark's tail ensemble. Thus, to obtain the desired elevator control forces an electrically operated adjustable incidence stabilizer is provided for longitudinal trim. This permits the choice of a smaller elevator area, the combination of short elevator chord and shielded-horn-type aerodynamic balance at the tips giving lighter stick forces than would be possible with a fixed stabilizer and tab-trimmed elevators. We are returning, in fact, to the practice of 30 years ago—the days before the servo trim-tab came into vogue.

Positive stability and effective control in the lateral-directional sense are also virtues greatly to be desired in shipboard aircraft. However—as in the realm and relations of *genus homo*—such virtues are seldom obtainable without accompanying vices in some degree or other, and so the final result is never quite the immaculate conception it promised to be on the designer's doodle-pad. This is plainly the case in low-wing aerodynamics applied to carrier aircraft, where the choice of dihedral angle is something of a compromise between the requirements of low and high speed—from approach and wave-off conditions to the vertical dive case. The required dihedral to pick up a dropped wing with either ailerons or rudder close to the stall may be excessive for high-speed dives where application of the rudder gives excessive roll and yaw. Conversely, if the wing dihedral is too flat, instability in roll will probably show up when the wing flaps and landing gear are pulled down.

Based on extensive wind-tunnel and flight research during the development of the Skyraider, the wing dihedral of the Skyshark remains the same at 6 deg, but the vertical location of the horizontal tail has been lifted, in effect, by the introduction of a 10-deg dihedral. Judging from the big "top-hamper" sail effect of the vertical tail, the rudder power looks adequate down to the stall, while the low taper-ratio of 0.5 and zero sweep of the wing should contribute towards effective aileron control throughout the speed range. Seeing that the Skyraider has positive stability and excellent control characteristics from the stall to a terminal velocity dive, and that the two types have similar wing-tail configurations, one may confidently expect the Skyshark to live up to its lineage.

One noticeable external change resulting from the turboprop combination shows up in the fuselage lines. Although of characteristic Skyraider shape terminating in a deep vertical knife-edge, the effect has been accentuated in the Skyshark by a big increase in depth and effective fin area aft of the wing. This increased vertical keel surface behind the c.g. is necessary, of course, in order to counteract the destabilizing influence of the lengthened nose, forward cockpit blister and large airscrew-blade "finnage." It may be just another dogmatic speculation on our part, but we suspect that this particular form of rear fuselage, with its smoothly integrated dorsal finning, induces a more effective weathercock yawing action than the appendix type of dorsal fin sitting atop a bluff rounded body. Albeit dorsal finning remains an elusive art—a blend of inspiration and desperation.

Hydraulically operated wing flaps of 40 per cent span by 25 per cent chord are of the Handley Page - N.A.C.A. single-slotted type having externally mounted plate-type hinges, which permit a large slot-gap when the flap is deflected. These hinges, while they openly violate the founding rules of the S.P.C.A., are clearly innocuous among the rest of the Christmas-tree decorations that seem fated to adorn the wings of most aircraft in the fighter-bomber category. It is astonishing, indeed, to note what *can* be hung on the lower surface of a wing in the way of bombs and rocketry without, apparently, impairing the performance too severely. (One is tempted to conclude that the airstream has developed the human trait of taking the line of least resistance; by crowding the flow over the upper surface, the lift may actually be boosted more than the drag!)

The air brake of the Skyshark is also operated off the hydraulic system, the brake flap being a quick-opening single panel mounted on the bottom of the fuselage just aft of the wing—similar in principle to the petaloid-type aft-fuselage air brakes first developed for the Skyraider. (The latter, however, has additional panels on the fuselage sides.) Douglas studies in this field of design have also encompassed wing brakes or spoilers, reversible airscrews and parachutes; and, as a matter of historical fact, the first U.S. dive-brake wing installation was evolved at the Douglas, El Segundo, plant (then the Northrop Division of Douglas) in 1935, being incorporated as double split perforated flap panels on both wing surfaces of the Northrop XBT-1 naval dive bomber—the primitive member of the long family line.

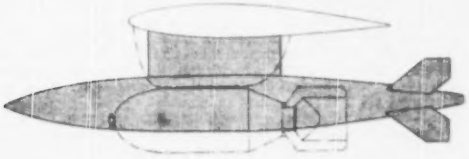
But, weighing up the virtues and vices again, the fuselage-type air brake has certain advantages over the wing-type spoiler. Actually, wing spoilers mounted well forward on the upper surface have a very high drag effect—as much as twice that produced by the aft-fuselage type for the same deflection angle. Offsetting this virtue, however, are a couple of vices; namely, greater structural difficulty in mounting on

the wing and buffeting from the spoiler effect with consequent poorer control in a dive. Contrariwise, the fuselage-type brake has practically no adverse control effect in a dive, the wing lift is entirely unaffected, and longitudinal trim changes are negligible. Although originally devised as a decelerator in dive bombing, the air brake has proved itself invaluable for manœuvring in combat and formation flying, and in rapid let-downs from altitude.

Punch and Performance

Like the Skyraider, the Skyshark carries its offensive punch of bombs, rockets or torpedoes on external wing racks instead of in a bomb-bay; however, to mitigate some of the parasite effect, serious attention has been directed to cleaning up the bomb racks in anticipation of a new streamlined 2,000 lb bomb, a combination which is estimated to be worth an extra 50 knots. (The aerodynamic motif is well brought out in the accompanying sketch.) Douglas engineers prefer the external armament arrangement, claiming that it permits a more flexible combination of bombs, rockets, torpedoes and droppable fuel tanks. They argue that the combat radius would have been no greater with internal bombs, for, while the latter arrangement gives a higher speed in approaching the target, the external scheme is faster after the bombs are released. Accessibility, no doubt, also played a big hand in the eventual arrival at this decision.

The external bomb racks on the continuous inner wing panel are designed to accommodate either three 2,000 lb bombs, three 1,300 lb 11.75 in *Tiny Tim* rockets, or three



Coniferous comparison: a conventional bomb and the new streamlined 2,000-pounder, intended to simplify the "Christmas-tree" problem in strike aircraft.

2,100 lb torpedoes. Alternatively, three 300-U.S. gal jettisonable fuel tanks can be mounted on these same racks. Normally, eight 5 in rockets are carried in launchers on the folding outer wings, but provision is made for additional rocket clusters. Defensive armament consists of four 20 mm cannon mounted in pairs at the outboard extremities of the inner wing close to the fold hinge, where the guns are readily accessible for servicing—especially so when the wings are folded.

No official weight-and-performance data have been divulged, other than the somewhat nebulous news that the bomb load is almost 50 per cent greater than that of the Skyraider, while the fuel consumption per pound of bomb per mile is substantially the same—a comparison which signifies a considerable jump in performance efficiency. To drive home the case for the turboprop still further, Douglas suggest that a contemporary turbojet design to accomplish the same mission would consume about four times the fuel. (Turbojets, of course, show up badly in this respect at low altitudes.) But in this specific case, the clinching argument in favour of the turboprop finally boils down to take-off performance, since the high static thrust of the T-40 engine permits the Skyshark to operate from even the smallest (CV-55) type carriers with ample deck-length margin as either fighter or bomber. Fully loaded for a bombing strike, the Skyshark takes off in roughly 330 ft, whereas its turbojetted counterpart would probably use up more than double this length.

To fill in the official vacuum, the airscrew side of the industry—rushing in with blades to grind—has come forth with some exuberant claims in the American aviation press concerning the top speed of the Skyshark and the prowess of its turboprop. While this form of turbopropaganda soon drops back into the ocean by the weight of its own saturation, it tends, unfortunately, to mask the real merit of the airframe designer's contribution. Starting with a modest 550 m.p.h. equipped with the present 14 ft Aeroproducts airscrews, the speed indicator quickly shot up into the 600-700 m.p.h. zone with the promise of "improved propellers" of the thin-bladed transonic variety—presumably reaching transcendental efficiencies. Needless to say, none of this wistful thinking can be charged to engineers of the calibre of the Douglas (El Segundo) design staff headed by E. H. Heinemann—to whom, we might say, we are personally indebted for much of the factual background of this causerie. A few elementary performance computations will point up the progress made on the airframe side.

Using sea-level top speed merely as a convenient aerodynamic yardstick, an approximate idea of such can easily be diagnosed from the published dimensional data and the known power potential of the T-40 engine. The take-off gross weight, as usual, is the mystic symbol in the equation, since it depends upon whether the aircraft is being used as a short-range fighter or longer-range bomber. The design gross weight of the Skyraider has been officially quoted at 16,500 lb and that of the Skyshark as approximately 17,000. However, in the overload condition for a long-range bombing strike, our own estimate of the respective gross weights has been assumed as standing at 22,000 and 23,000 lb, with corresponding take-off powers of 2,700 and 5,500 b.h.p.

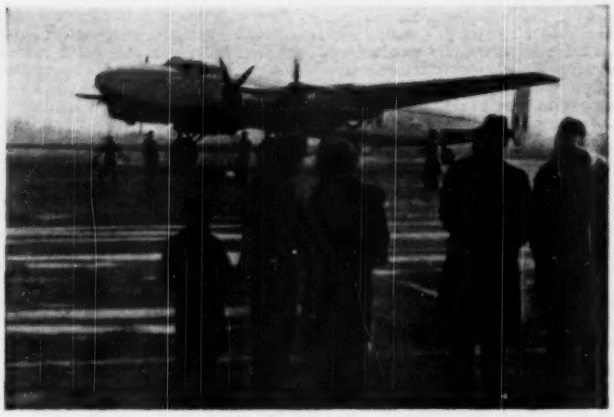
Study of a three-view layout of the Skyshark (see Part I) gives the following approximate overall dimensions and areas: wing span, 50 ft; length, 42 ft; height, 15 ft; and net wing area (excluding body gap), 350 sq ft. From this basic design-pattern, the aerodynamic characteristics fall into shape with an effective aspect ratio (based on a net span of 45 ft and a span efficiency factor of 0.90) of 5.2; and a minimum parasite drag coefficient varying from 0.018 to 0.022, according to the wing armament or cleanliness condition. Maximum propulsive efficiency with present airscrews has been assessed at 0.83. In the clean-wing or fighter condition (W = 17,000 lb), standard performance procedure turns up a sea-level top speed of approximately 470 m.p.h., while in the bomber condition with full wing decorations (W = 23,000 lb), the top speed drops off to roughly 440 m.p.h. Thus, in relation to the newspaper flights of 550 m.p.h., the "credulity coefficient" stands at 0.80.

Unhappily for the engineer, this kind of over-statement gives an entirely false impression of the real gain achieved on the airframe side, since the performance of the Skyshark must be compared *vis-à-vis* its predecessor. Our own estimate of the Skyraider's top speed in the bomber condition (W = 22,000 lb) is 315 m.p.h., assuming a parasite drag coefficient of 0.028 with the older-type bombs and racks, and a propulsive efficiency of 0.85. If now the 5,500 h.p. of the T-40 could be substituted for the 2,700 h.p. of the Cyclone, the maximum speed of the Skyraider would be raised to roughly 400 m.p.h. The gainful increment of 40 m.p.h. (440 – 400) obtained from the Skyshark is thus a fair measure of the improvement achieved purely through aerodynamic spit and polish; and this is quite apart from the big increase in military load. It represents, in fact, the airframe progress as distinct from the bigger pull of the turboprop combination.

A final interesting point to note is that should the airscrew designer raise his propulsive efficiency from 0.83 to 0.92 (as promised for thin blades), the top speed of the Skyshark would still be only 455 m.p.h. Clearly, then, the 600-700 m.p.h. band of the airscrew spectrum is still something of a rainbow vision insofar as current turbopropped aircraft are concerned. None the less, the Skyshark can stand squarely on its own merits, for it not only has all the airmarks of a rugged successor to the Skyraider, but in the writer's opinion it marks a definite step forward in the naval aircraft design art. "No gingerbread" has long been the established design philosophy of its designer, but unless our slide-rule deceives us, the Skyshark has plenty of performance ginger and may well turn out to be bread upon the waters for Douglas.

Global Classroom

Six Long-range Exercises by Staff and Students of the R.A.F. Flying College



"Aries III," which last Friday completed a 25,000-mile circuit of the world, is seen at Manby on its return to the College.

Illustrated with "Flight" Photographs

LINCOLN RF362 landed at Manby in typical grey English drizzle at 1500 hr last Thursday, November 16th. It had been away since October 18th, carrying students and staff of the Royal Air Force Flying College on a 10,000-mile tour of liaison with the Royal Canadian Air Force, and made its touch-down exactly on schedule.

Two minutes later, as RF362 taxied round the perimeter-track to the spot near the control-tower where the Commandant (A. Cdre. A. McKee, C.B.E., D.S.O., D.F.C., A.F.C.), wives and families—and "Customs"—waited to receive its crew, a second Lincoln landed in completion of a similar mission. By 1430 hr the following day four more College aircraft had arrived and the process of extracting and analysing information from the experiences gained in six simultaneous long-range liaison flights had begun.

The charter of the R.A.F. Flying College, which was formed last January to combine and concentrate the work of the three Empire Schools (of Flying, Navigation and Air Armament) stated that selected officers would be given "a practical course in flying in all-weather conditions, and in navigation and the use of weapons, so that they will be able, by their own knowledge and example, to train those under them in the most effective use of aircraft as weapons of war."

An ambitious aim—which could not succeed if static, academic methods of instruction only were used. "Practical" is the operative word. Thus it was laid down that students of the College should visit "appropriate research and development establishments and Commonwealth and Allied Air Forces." Such visits, of which the six flights reported here stand as a combined example, are undertaken in the third phase of a 48-week course, which, incidentally, takes 32 officers holding permanent commissions as squadron leaders or wing commanders. Of these, 28 are normally pilots and four are navigators; and all are highly qualified and in current flying practice.

College staff officers, as well as students, flew on all six missions, for they, too, require the valuable background of experience offered thereby. Incidental, but important, opportunities of these primarily educational flights were those of exchanging the knowledge and opinions of the air forces concerned through the best possible medium—personal contact between practical airmen. Each aircraft carried a team secretary who will submit the collated experience of each aircrew-member in a single report, thereby ensuring that knowledge gained in a personal way will be studied and applied from a broader viewpoint.

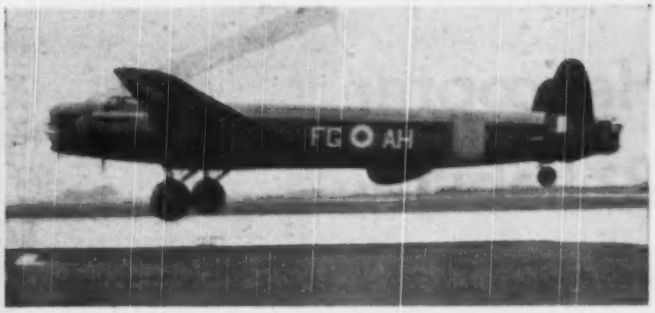
Examples of the cold-weather clothing developed by the R.A.F. at Farnborough and tested in Northern latitudes by three of the Manby crews.

600 Flying Hours

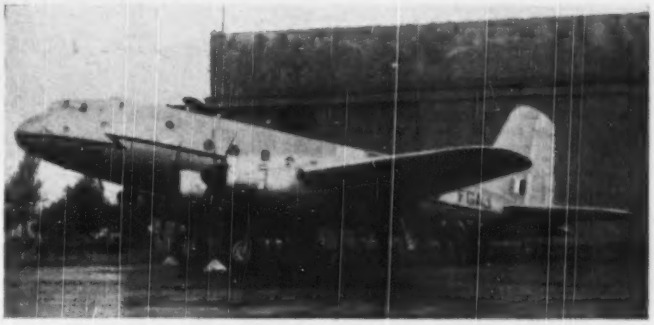
The six flights—made by five Lincolns and a Hastings—entailed some 600 hours in the air and covered a total distance of 100,000 miles, crossing 17 countries. Their interest is found mainly in the places visited and the people met by the crews on their travels; the trouble-free and punctual schedules flown, though incidental, reflect the excellence of the aircraft, their flying crews and the small, hard-working Manby ground staffs they carried.

The first aircraft to return was, as mentioned, Lincoln RF362, captained by S/L. R. S. Radley, D.F.C. It had left Manby on October 18th and made its way, *via* Keflavik, Goose Bay and Ottawa, to Edmonton, the base of the R.C.A.F. Winter Experimental Flight, where the crew learned of the problems of cold-weather flying faced and overcome by the Canadians. They were able to study a newly completed analytical report on Exercise *Sweetbriar*, a recent R.C.A.F.-U.S.A.F. combined effort under Arctic conditions. At Whitehorse, temperatures of "40 below" were encountered and the Lincoln's engines required several hours' pre-heating to ensure starting. Matters of general Service interest were discussed at a number of stations, including the Canadian Central Flying School at Trenton, and members of the team delivered lectures to the R.C.A.F. They also toured the National Research Council laboratories at Ottawa and saw at work the well-known icing-research North Star *Rockcliffe Ice Wagon*, which recently visited this country. A similar programme was undertaken by a second Lincoln, RF380, captained by S/L. E. W. Tacon, M.V.O., D.S.O., D.F.C., A.F.C. (a former C.O. of the King's Flight), which left Manby, and returned there, at the same times.

Next back at Manby, at 0930 hr on Friday, November 17th, was Lincoln RF358, flown by S/L P. A. H. McKeand, D.S.O., D.F.C., A.F.C., which had flown direct from Gander in just over ten hours. On this last lap its air-speed indicator failed



(Above) *A. Cdre. McKee, the Commandant of the College, greets one of the captains, S/L. McKeand, on his return from Alaska.*



(Above, right) *Touching down at Manby: Lincoln RF362, the first aircraft to return.*

(Right) *This Hastings flew 26,000 miles on its visit to Australia and New Zealand.*

just after take-off but S/L. McKeand rigged up a makeshift pitot tube which projected from the fuselage to give readings correct to within five knots for the whole trip, with the aid of occasional manual de-icing. This Lincoln left the College on October 19th for a tour—of American bases in the Arctic Circle—which probably discovered more techniques of topical interest than did any of the other flights. The crew visited fighter, bomber, rescue and weather-reconnaissance stations operating regularly under sub-zero conditions and were as one in their admiration for the drive and boldness with which the Americans are tackling the many problems involved. Two of the navigators and the captain flew over or near the geographical Pole in RB-29 reconnaissance aircraft of a weather squadron based at Elmendorf Anchorage.

The unit concerned sends a met. flight to the Pole every other day, flying for 18 hours at 18,000ft, and has logged nearly 400 sorties of this type without losing an aircraft. On alternate days, similar flights are made along the Aleutian chain of islands.

The navigators were, of course, particularly interested in the grid system of navigation and the sun-compass recently adopted to overcome the former impossibility of position-fixing during the long twilight period. This instrument polarizes the light of the sun below the horizon and focuses it into a peak, accurate within a degree, from which position may be calculated and the gyro monitored accordingly.

Cold-weather Clothing Tested

Like the crews of the Lincolns which visited Canada, the Alaskan team wore cold-weather survival clothing developed by the R.A.F. Institute of Aviation Medicine at Farnborough. Practical tests gave encouraging results—suggestions brought back were for minor modifications only—and in some ways our Arctic clothing proved more effective than that of the U.S.A.F.

The fourth "flock" (College designation for the flights) to return was Lincoln RF405, which landed at 2 p.m. on Friday afternoon. It was captained by W/C. D. C. McKinley, D.F.C., A.F.C., and left Manby on October 20th, replacing the former Armament-School Lincoln *Thor II*, whose departure the previous day was held up by unserviceability. W/C. McKinley's team visited all the major experimental stations of the U.S.A.F. and U.S.N., including Patuxent, Wright Patterson, Edwards (at Muroc Dry Lake) and Eglin.

Of these centres, Muroc had the greatest practical appeal, for almost-daily supersonic flight is but one of the advanced testing activities centred on its seven-mile natural runways. Other interesting sights were found at Eglin, the Air Proving Ground, including a giant hangar (capable of holding six Brabazon-size B-36 bombers) in which are produced any conditions of temperature and humidity. The team's experiences were not entirely static and the U.S.A.F. enabled some of its members to fly a B-45 jet bomber, two jet fighters (F-80 and F-86) and the new North American T-48 trainer.

The elongated silver nose of *Aries III*, which landed at Manby at 1405hr on Friday, held a tank for extra fuel to assist this modified Lincoln on its 28-day, 25,000-mile flight round the world. (The *Aries* held 4,600 gallons; the other Lincolns carried wing and bomb-bay tanks of over 4,000 gallons' total capacity.) *Aries* set off for Khartoum on October 20th and arrived 14½ hours later to break the previous non-stop record for this journey (17hr) set up by a Commando of the Egyptian Air Force. The aircraft's second hop carried it to Mauritius, whence it set off for the first west-east crossing of the Indian Ocean, using pressure-pattern navigation for the 3,200-mile journey to Perth. Shortly after take-off the artificial horizon failed, but Sgt. Rowden, the instrument repairer, installed another in the startling time of 1½ minutes. Having reached Western Australia in less than three days' elapsed time, with two very brief pauses separating the three long stages, the crew of *Aries* appreciated the less strenuous 11-day tour of R.A.A.F. stations (plus a meeting with the M.C.C. cricket team) which followed. Keeping to schedule, they flew to San Francisco *via* Nandi (Fiji) and Honolulu, and thence back to Britain by way of Bermuda. *Aries* was captained by S/L. J. C. T. Downey, D.F.C., and its crew included Lt. Cdr. D. B. Law, who led a Naval aerobatic tour of the United States two years ago, and Lt. Col. Knobloch, U.S.A.F.

Hastings TG617, which landed half an hour after the globe-girdling Lincoln, had actually made the longest flight (about 26,000 miles) of the six. S/L. Smith, a Canadian, captained the aircraft (which carried a total of 18 aircrew and ground-crew) and G/C. C. G. Lott, C.B.E., D.S.O., D.F.C., was the team-leader. The Hastings set off for Darwin on October 18th, arriving five days later *via* Malta, Habbaniya, Mauripur, Negombo and Changi (Singapore). The aircraft behaved perfectly: "There were no snags and we kept right to schedule," said S/L. Smith. It travelled 5,000 miles over Australia and New Zealand before returning to Britain by the same route on November 10th, and the major Australasian Service stations were visited. Mutual problems—both technical and administrative—were found and discussed with the two relatively small but "keen and up-to-date" forces; it might be safe to say that hosts and visitors benefited alike from this pleasant and successful mission.

Helicopter Reliability

Maintenance at ½ Man-hour per Flying Hour Claimed for Hiller 360

The 1950 Hiller helicopter for agricultural duties, showing the new cylindrical tanks capable of holding over 80 gallons of fluid.

A REPORT recently issued on the maintenance requirements of the Hiller 360 light helicopter contains some interesting figures based on the accumulation of facts from a wide variety of Hiller operators. It is pointed out that, in the compilation of the report, there was a wide variation in the man-hours required for maintenance operations, this being a function of the varying experience of mechanics, auxiliary maintenance equipment available, and "progressive" maintenance undertaken.

In deriving operating costs, an average of 0.66 man-hours per flying hour was used, but subsequent improvements to the serviceability of the Hiller 360 tend to indicate that this figure is high, and that the average will be closer to 0.5 man-hour maintenance per flying hour. On this basis, the operation of a single helicopter in most circumstances will not warrant the employment of a full-time mechanic and, in fact, one would be needed only for relatively high utilization figures involving two or three Type 360 helicopters. The present standard of manpower requirements is as follows:—

Type of check	Man-hours		
	Aircraft	Engine	Total
25-hour	2	3	5
100-hour	16	12	28
300-hour	16	*24	40
600-hour	24	†32	56

* Includes top overhaul of engine.
† Includes engine exchange for major overhaul and transmission inspection.

Most of the operations undertaken at the 25-hour checks need not be handled at one time, and it has been found practicable to operate the helicopter normally and undertake the operation of such a check during non-flying time on two or three consecutive days.

Further analysis of the various checks required for different annual utilizations indicate that the maintenance day requirements can be tabulated as follows:—

Hours flown per year	Days required for:		
	*25-hour checks	†All other checks	Max days required
400 hours	6	4½	10½
500 hours	7½	5½	13
600 hours	9	7½	16½
700 hours	10½	8½	19
800 hours	12	9½	21½
900 hours	13½	11	24½
1,000 hours	15	12	27

* Only required if Hiller 360 operation is such that no time is available during day for checks; this occurs rarely.
† Minimum "out-of-service" time for 100, 300- and 600-hour checks.

It is significant that for 1,000 hours' operation per year, the aircraft would be unavailable for service on an average of only one day per month, provided that the 25-hour checks could be handled in the manner suggested. In actual practice, it is claimed, there have been numerous occasions when these helicopters have operated for months on end without undergoing any maintenance other than occasional checks by the pilot. At the end of these 100- and 200-hour operational periods, the most careful inspection has indicated that no significant problems are likely to be encountered.

The study of maintenance materials was handled in a somewhat different manner from that outlined for maintenance man-hours, and lists were compiled covering every item which could possibly have to be replaced at the end of certain operating periods. The figures are thus conservative in that they embrace the maximum possible replacements rather than those indicated by experience.

All estimates on the engine include the assumption that an engine exchange will be effected at the end of 600 hours' operation. For such cases, where the engine overhaul is handled by the operator's personnel, it has been found that the material costs average $250 (£89), and that the labour requirement is 120 man-hours. This figure has to be compared with the allowance of $1.25 (9s) per flying hour, or the $750 (£268) for engine exchange at the end of 600 hours. The costs of engine parts for other operations are respectively $12.16 (£4 7s) at 100 hours and $54.32 (£14 10s) at 300 hours.

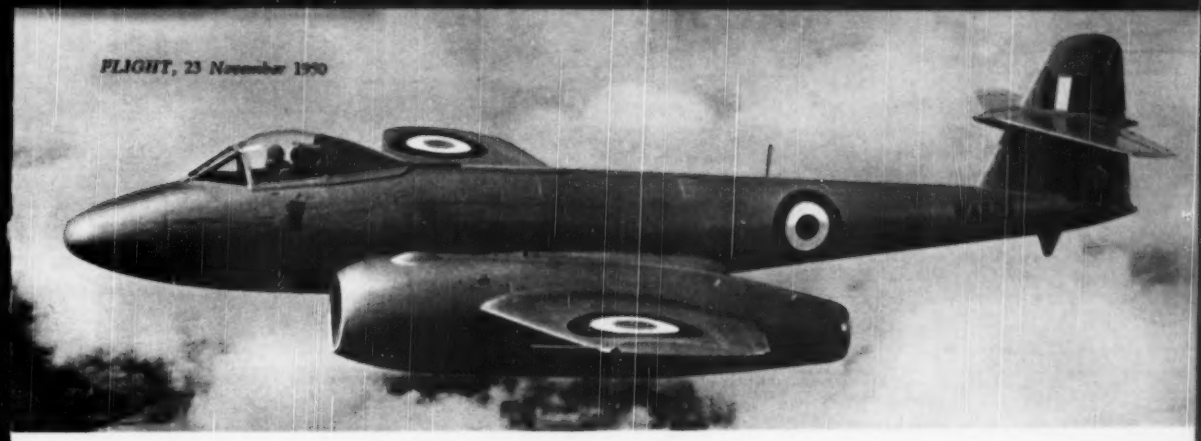
In addition to the above amounts, an allowance of $0.20 (1s 6d) per hour is made to cover those small items which have to be replaced occasionally in between major overhaul periods. Averaging out the above figures, it would appear that an allowance of 3s per operating hour is ample to provide a reserve to purchase all engine parts and supplies which could be required, with the exception of those involved in major overhauls.

The helicopter itself has the following parts costs:—

100-hour check	$3.16 (£1 2s. 9d.).
300-hour check	$70.17 (£25 1s. 3d.).
600-hour check	$865.37 (£309 2s. 2d.).
1,200-hour check	$1,165.77 (£416 7s. 2d.).

Again averaging these figures for the annual operation of the Hiller 360, and adding $0.20 (1s 6d) per hour to cover such items as grease, safety wire and so forth, it would appear that a figure of $1.68 (12s) per operating hour should amply cover every possible maintenance-part requirement.

In this country Pest Control, Ltd., who are very interested in the Hiller, now own three examples. Two were shipped from America, and as soon as they had been inspected at Hurn were despatched to the Sudan (by Hunting Air Travel). The third is being assembled at Cambridge under A.R.B. observation. The two despatched to the Sudan had sprayed their first 6,000 acres within a week of arrival and, their work completed, they are expected home next month. The United Kingdom agent for the Hiller Helicopters Inc. of America is C. Colin Cooper, c/o The Helicopter Association, Londonderry House, 19, Park Lane, London, W.1.



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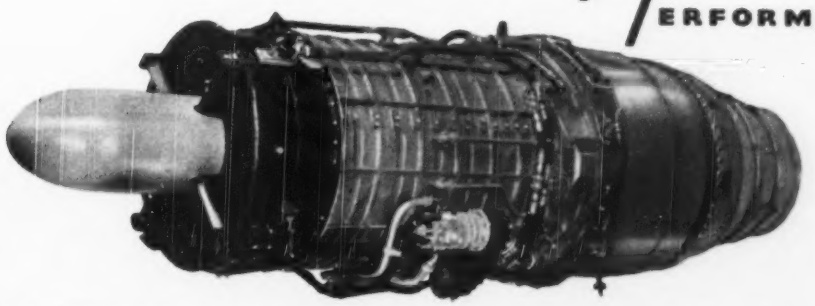

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FIGHTER ARMAMENT

A Bell Airacobra firing at night with a 20 mm cannon (through the airscrew hub) and machine guns in wings and fuselage.

Part IV: Ammunition and Elementary Ballistics : Vulnerability of Structures

By . . . A. R. WEYL, A.F.R.Ae.S.

TO-DAY there is no longer cause to maintain that airborne weapons should be adaptations of those of the Army or Navy. The latter have to satisfy requirements that are entirely different and are not of the slightest importance in the air. It used to be said that, when the Army wanted to test a new gun, they first dropped it from a high tower several times, buried it in mud for some weeks, let a blacksmith use it as an anvil, and only then began firing trials. For infantry weapons this may have been an excellent procedure; applied to airborne guns it would prove nothing. The aircraft gun receives expert attention from armourers on the ground; when it is in the air it must either shoot or be damned. It can be heated, treated with anti-freeze lubricants, kept dry and clean, and fed with carefully selected ammunition. It must, however, *automatically* remove any unfired round left in the breech and clear stoppages; the mounting must suit aircraft installation practice and possess a recoil buffer which leaves the barrel free; and the gun must give the highest possible rate of fire, in very short bursts, and at immediate trigger response. It must also be light, small, and utterly reliable. On the other hand, its life does not matter very much, production costs are not vital, and rapid interchangeability of all parts is not absolutely essential.

There is no reason to discard, say, electrical ignition of the propellant charge, or a combustible cartridge case, because the Army or Navy cannot or will not have such features. The barrel-safety of the ammunition, too, can be restricted to, say, ten yards in front of the muzzle. In an Army weapon, this might be quite unacceptable.

The best results will be achieved solely when the conditions peculiar to air interception are fully understood and completely interpreted in requirements. This, too, applies to the necessary distinction between air combat and ground interception. The conditions imposed are generally incompatible. Attacks on tanks and sea vessels principally

In the first part of this article (August 24th) Mr. Weyl reviewed the history of aircraft armament and showed how lessons of the past had, in his opinion, been neglected by those responsible for developing British equipment in the Second World War; in the second instalment (September 21st) he discussed German equipment; in Part III (October 5th) he analysed the respective claims of guns versus rockets; and in the present contribution he discusses the effectiveness of various types of shells and fuses, and goes on to review some important aspects of elementary ballistics in relation to air armament.

demand armour penetration. To achieve this by impact (as is necessary with small- and medium-calibre shells) a high muzzle-velocity and great section-density (mass divided by maximum cross-sectional area) are indispensable. Consequently, the rate of fire and the H.E. charge of shells suffer. These characteristics are in direct conflict with those desirable in air combat; yet we still find that one and the same fighter aircraft, with practically identical guns, is scheduled for all purposes.

Shell-gun Ammunition.—Shells carry explosives, and rely for their effectiveness upon fuzes which detonate the charge at the correct instant so as to cause maximum destruction, i.e., at a point along the trajectory where blast and splinters will produce maximum damage to the target.

With small-calibre shells, the design of reliable fuzes is intricate, because of the inadequate space available. Fuzes have to resist the shock of firing (of the order of 100,000 g), and must retain their function in spite of heat and centrifugal forces. They must be perfectly barrel-safe, and insensitive to rough handling during transport, storage and feeding.

A fuze may act upon one of four general principles: time, percussion (impact), motion changes, and proximity to the target. With airborne weapons, time fuzes are not now used, except for self-destruction after missing the target. To set

FIGHTER ARMAMENT . . .

fuzes correctly during air combat means accurate range-determination, which is not easily accomplished. Nevertheless, it would seem possible, with the aid of fully automatic ranging and fuze-setting devices, to reach practical solutions. An automatically following-up fuze-setter (such as was used in the 1918 Szakatz-Eisenach gun) and monitoring by radar ranging might be a step in the right direction. Like the proximity fuze, time fuzing has the advantage that narrow misses can have effect upon the target; with impact fuzes such misses are simply waste of ammunition. Moreover, in a time fuze, a separate (secondary) self-destruction device becomes unnecessary; when aircraft are attacking in formation, wasted projectiles are less apt to present danger to the user's side in a mêlée.

In design, the "burning-composition" fuze is probably simplest and safest; yet it is possible that other types might be superior. Percussion fuzes still predominate. In view of the "dissolved" character of modern airframe structures, they need exceptional sensitivity combined with nearly instantaneous action. For "mine" shells, some delay in the fuze action is advisable, because blast destroys stressed-skin structures more effectively when acting from the interior outwards. The reliability of small percussion fuzes is still the cause of many headaches. Fuzes reacting to changes in attitude are of use only as secondary devices to cause self-destruction of a spent shell.

The most intriguing principle is that of a fuze which detonates the shell when it is at a minimum distance from the target. The Admiralty (prodded by Mr. Churchill) was leading in the development of a photo-electric proximity fuze for A.A. projectiles. Later, A.A. shells had British-invented fuzes based on radar ranging. Such fuzes, with their miniature valves and batteries, require rather large calibre because of their bulk. Detonation takes place when the time interval between emitted and echoed impulses is at a minimum.

In view of the very short ranges which characterize air combat, shell fuzes of this kind might be too delicate as to be practical and/or safe. There exist, of course, other possibilities for action at close quarters—as, for instance, the use of electrostatic triggering on the capacity principle.

Though it is foreseen that the present method of destroying enemy aircraft in combat by direct hits only will eventually be superseded by the use of proximity-bursts, it must not be overlooked that such development is closely linked up with the calibre question. Quite apart from obvious design-difficulties, proximity fuzes present little advantage for calibres of less than, say, 40 mm, because close detonation will then do little harm to the target. Even with a splinter-forming 3.7in (94 mm) A.A. shell, the lethal sphere has a radius of approximately 30ft only. Hence, for the 30 mm shell-gun to which this country seems to have pledged the immediate future, the adoption of proximity fuzes would offer no tactical gain worth achieving. As far as bigger calibres are concerned, fuzes of this kind would widen the prospects of attacks with short bursts over wider ranges, and ease the problem of ammunition wastage.

Another important question is whether action by splinters or by blast is more effectual. Any detonating shell or rocket, of course, produces both; yet it is in the hands of the weapon designer whether one or the other shall predominate: for extensive splinter-formation, his shell will have thick walls of tough steel; for blast, a thin-cased ("mine-type") container with much high explosive will be essential.

In this country, the preference is towards splinter formation as being most effective against aircraft. This view is held because a shell designed primarily for action by splinters possesses, by reason of higher section-density, better ballistic properties. Moreover, the "lethal zone" (i.e., the space adequately covered by splinters of sufficient kinetic energy for certain destruction) is bigger.

Even before the late war the Germans decided in favour of thin-cased mine shells, with predominantly blast action. For the 20 mm Oerlikon MG.FF such ammunition (carrying 19.5 grammes of H.E. per shell) was introduced. During the war, the Luftwaffe found no cause to change this policy, while raising calibres to 30 mm and, later, to 50 and 55 mm. The last German systematic experimentation in ammunition development fully confirmed the superiority of action by blast.

The reason is that, although blast produces a smaller lethal zone around the point of detonation, stressed-skin structures are far more prone to collapse under action of blast than when pierced by splinters. The time is past when a few, relatively small, vital members—such as spars, struts, longerons and cables—made a vulnerable main structure sensitive to hits by splinters but practically immune from blast. Even when one of the massive main spars of a modern stressed-skin aircraft is pierced by splinters, the additional stringers and the skin connected therewith will still retain sufficient strength. When, however, intense blast waves react upon exposed fields of thin-gauge, stress-carrying metal sheet, a general collapse of the structure often follows. The proper mechanics of the blast action in such circumstances are complicated and not easily understood. During the war, the author suggested the exploitation of the self-frequency of free sheet fields (which does not vary greatly so far as unsupported fields of identical material are concerned) for easier destruction by an appropriate selection of explosive and shell; it was, however, rightly held against the proposal that the frequency spectrum of all explosives was too large. Also, a fuel tank is more likely to discharge its contents by splitting open under blast than when pierced by splinters.

For the future, another aspect in favour of blast-action is the strong incendiary effect of high explosives. Turbojet and rocket-propelled aircraft carry plenty of ignitible or even explosive fuel in a number of places, and are, hence, more vulnerable to incendiary action. The use of special incendiary shells can thus be dispensed with.

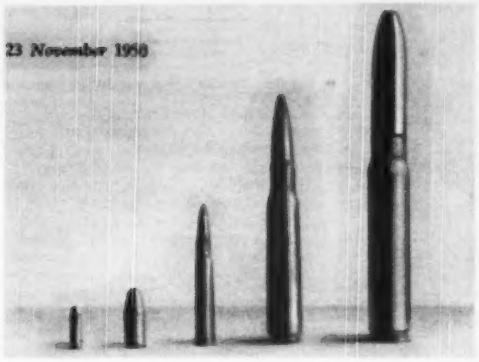
Ballistic Properties.—Once the shell leaves the barrel, no further energy is imparted to it. Because of the action of gravity (which is not *a priori* counteracted by a lift force on the projectile) trajectory drops, i.e., the path described becomes inclined earthward. Since the shell also suffers air resistance, the subsequent parabola foreshortens; and the higher the drag the greater is this foreshortening. Hence, when a gun is fired at great altitude, the shell's trajectory becomes flatter than when it is fired near the ground. Consequently, for air combat at high altitude, a lower muzzle-velocity may produce a trajectory comparable with that of a high-velocity gun fired near sea level.

The characteristic shape of the trajectory, too, is affected by shape, section density, and stability of the shell. The shape decides the air resistance. Section density is a parameter akin to, but somewhat different from, the wing loading of an aircraft; the higher the section density, the greater the kinetic energy of the shell in respect to air drag. The stability of the shell in flight not only affects the trajectory on account of the magnitude of air drag, but may alter it by producing deflecting forces. Shells fired successively by one and the same gun with an identical charge always vary in their trajectories, and hence cause dispersion of bursts.

The flight-path of a shell is not so regular as some text-books will have us believe: because of the spin, and because of the action of the air, a variety of additional forces and moments develop: the shell does not remain in the same vertical plane, and it does not fly truly with its longitudinal axis tangential to the trajectory. In fact, a shell's trajectory is a rather complicated affair, full of kinks and bends.

To hit a target in air combat, two qualities are paramount: "drop" and "dispersion." In the same gun, different ammunition produces variations in both. H.E. shells, for instance, commonly have greater dispersion and drop than does armour-piercing or ball ammunition (high explosive is of about one-fifth the weight of steel).

Single-shot dispersion is a measure to show the deflection of a single shell from the point it should have reached in accordance with the aim taken. *Burst* dispersion is commonly given as the ratio, to the range, of the circle through which half of the trajectories of all shells pass. To consider only half of the shells fired is arbitrary but practical. The circular area thus delineated (normal to the line of sight) is defined as the lethal area covered by a gun



Calibre comparison : (left to right) 0.22in ; 0.455in revolver ; 0.303in ; 0.5in ; 20 mm. The two last-named rounds have "rimless" cases.

fired with a perfect aim. This "technical" dispersion—peculiar to the gun, its installation, and its ammunition—must be multiplied by a "personal" factor peculiar to the man concerned. For an average marksman, this factor approaches a value of 0.5.

In the Luftwaffe, an evaluation of films taken during actual air combats proved that average shots achieved aiming dispersions of 10 to 12 per mille of the firing distance, whilst good marksmen had 8 per mille aiming dispersion only.

A four-engined medium bomber may present, from the position of attack, a target area of, say, 300 sq ft. The lethal area calculated on the basis of technical burst-dispersion and the personal factor may be, for the range at which fire is opened, 7,000 sq ft. Then, at best, no more than $(300/7{,}000) \times 100 = 4.5$ per cent hits can be expected of all the shells fired during this burst. For a 20-sec burst from four 20 mm guns, about four hits could thus be reasonably expected. Actual air-combat experience has yielded dispersion values of 2 per cent of the range with 20 mm guns, i.e., the diameter of the lethal circle at 600 yards' range was not less than 72ft, or about three-quarters of the span.

"Fire density" means the number of shells which penetrate the lethal circle within a given unit of time. High fire-density and small dispersion are, for a given projectile, guarantees of success in air combat.

Self-propelling missiles, such as rockets, have energy of motion imparted to them because of the thrust force; when the force ceases, they behave like gun-fired projectiles. The thrust force prevents neither drop nor dispersion; but the trajectory becomes flatter because of the retention or increase of the speed. Salvo-firing experiments with the original model of R.4/M proved a technical dispersion of approximately 10 per mille over ranges of 200 yards. Improved types exhibited substantially less.

The "time of flight," i.e., the interval between ignition of the propellant charge and impact on the target, is another factor important for probability of destruction. The flying target moves over considerable distances whilst the projectile is under way. The greater the range over which the fire is opened, and the slower the projectile, the less the probability of a hit. As to manœuvrability, the faster the target the less capable will it be of changing its course quickly, so the use of automatically computing sights is a quite practical method of coping with the situation. The ideal case is, of course, the pilotless aircraft, which is unable to take evasive action.

The preceding reference to dispersion concerned firing from an aircraft in the direction of flight. Queer things happen when firing at an angle to this direction: aerodynamic forces then deflect the projectile, because it enters the air stream obliquely. With a fast spinning shell, a Magnus cross-force results from the circulation.

When leaving the muzzle, the shell's trajectory is determined by three imposed motions: translation along the barrel; velocity of the muzzle in respect to the air at rest; and rotation due to spin. Deflections of the shell due to aerodynamic forces produce, in turn, gyroscopic effects. When these deflections can no longer be neglected (i.e., in view of high aircraft speeds and long ranges), due allowance must be made in the technical dispersion if the barrel does not point in the direction of the intercepter's motion. Semi-flexible gun installations—which, because of reduced manœuvrability, might eventually become necessary for supersonic intercepters—present particular problems in the adaptation of automatic computing and triggering sights.

The trajectory of a rocket, too, greatly depends upon the motion of the "platform" from which it is launched. Supersonic missiles, like the R.4/M, preferably have initial guidance, such as launching tubes or rails; the optimum length of these is critical. Also, the attitude of the rail in respect to the path of the launching aircraft has an effect upon the subsequent trajectory. Spinning rocket-missiles produce higher dispersion than fin-stabilized, unrotated ones.

A major disadvantage in intercepters flying near their critical Mach number is their lack of steadiness in yaw. Present-day high-speed intercepters suffer from "snaking," i.e., from undamped yawing oscillations. This presents a great difficulty in air combat. Somewhat belated steps are now taken to provide gyroscopic "auto-stabilizer" devices to suppress snaking and give a steady gun platform. These devices (an experimental model by the R.A.E. was recently shown at Farnborough) allow the pilot free use of the rudder for taking aim.

(*To be continued*)

FACILITATING FLIGHT-RESEARCH

A USEFUL flight-test research tool has been developed by Blackburn and General Aircraft, Ltd., to supplement the scope of the automatic observer. Known as the Pressure Scanner, the device is basically a selector valve, into which run pipes from each point at which pressure is to be measured, and from which are connected a number of pipes to the pressure-recording instruments. The input ends of the pipes connected to the instruments are carried on a moving member in the scanner, which is driven in controlled steps across the ends of the pipes from the vents. By this means, each instrument is connected successively to a number of vents, so allowing the pressures at a large number of separate points to be individually recorded by a small number of instruments.

The instrument panel is photographed by a camera automatically timed so that the exposure is made just before the moving member transfers from one row of pipes to another. Instrument lighting is synchronized with the camera to reduce the electrical load, and the time allowed for the instrument reading to settle (three seconds) is more than enough to avoid lag in any normal length of pipe connecting the scanner to the vent. Such a scanning speed allows individual pressure measurements to be made at the astonishing rate of 300/min, while using only 30 instruments.

FLEXIBLE BEARINGS

IN the orthodox flexible bearing, inner and outer metal elements are usually bonded by an intervening rubber sleeve, the elasticity of which permits partial movement of one element in relation to the other. In an unusual modification of this method, seen in the patented Clayflex bearing, there is the important difference that the rubber sleeve is not adhesively bonded to the metal; instead, it is stretched to a greater axial length before assembly, with the result that it assumes a permanently "active" state in which it tries to return to its former, larger diameter. This tendency, however, is prevented by the metal sleeves, so that a constant radial pressure is exerted which effectively prevents any creep between metal and rubber, provided the approved angular movement (up to 70 deg, according to bearing type) is not exceeded. If it is exceeded, the rubber will not tear; the bond is, in effect indestructible.

For bearings intended to work in the presence of certain oils and other liquids, and in extremes of temperature, special synthetic elastic elements are used instead of natural rubbers.

Some of the hundreds of standard Clayflex bushes, together with various special applications, are illustrated in a catalogue issued by the makers, Howard Clayton-Wright, Ltd., Wellesbourne, Warwickshire.

The Vampire Trainer was seen for the first time in public at the S.B.A.C. show last September. ("Flight" photograph).

VAMPIRE TRAINER

Details of the New de Havilland D.H. 115 Two-seat Side-by-side Instructional Aircraft, Developed from the Night Fighter

THERE has recently been a good deal of outspoken opinion on the production of military equipment (or the means of making that equipment) for foreign countries. Certainly, aircraft have not been too directly involved in the acrimony, and we only mention the matter as being in some way relevant to the genesis of the subject of this article, the D.H. 115 Vampire Trainer.

Had it not been for foreign buyers, it is quite possible that the Vampire Trainer—and with it the Vampire Night Fighter and the Venom—might never have existed as such. When, some seven years ago, de Havillands had the enterprise to design the original Vampire, their production commitments for the various types of Mosquito and Hornet were such that they could not undertake quantity production of the new design, and the Vampire was, in fact, produced by the English Electric Company. De Havillands, however, realized that, with the tailing-off of Mosquito and Hornet production after the war, the Vampire offered an attractive fighter solution to the air-defence problems of many friendly foreign governments; and, after some discussion with the Ministries concerned, the company undertook the manufacture of Vampires.

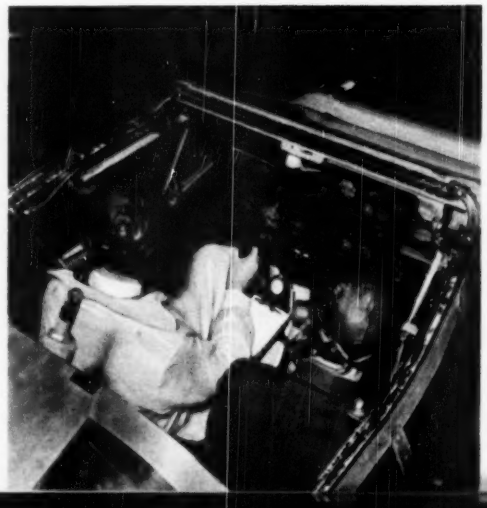
Certainly, some of the Vampires produced by de Havillands have gone to the Royal Air Force, but the production for foreign Air Forces—no fewer than 12 of them—has resulted not only in the obtaining of several million pounds' worth of overseas trade, but also—and in the ultimate analysis, perhaps even more important—it has resulted in de Havillands amassing sufficient experience with the design to enable them to undertake the successful development of variations on the basic theme.

By installing a Ghost in a modified Vampire airframe, and by extending the span, the world's altitude record was pushed up to only a trifle short of 60,000ft. The Ghost engine installation, and the high-altitude characteristics of the record Vampire provided data which, together with a modified wing, have resulted in the development of the Venom. Again, by wedding a Mosquito night-fighter cabin and nose to the basic Vampire, the night fighter was evolved; and, as an extension of the theme, by modifying the night fighter cockpit still further, the Vampire Trainer has been evolved, while a night-fighter Venom has also been produced. Thus, quite aside from the ordinary Vampire *per se*, four vastly important logical derivatives have come into being in a manner which might well never have occurred had not de Havillands had the courage and obstinacy to undertake Vampire production themselves.

As to the Vampire Trainer itself, the prototype was seen by thousands of interested spectators in the "static park" of the S.B.A.C. show at Farnborough in September. It was hurriedly prepared by Airspeeds at Christchurch and, after the show, was taken back to the experimental department of this associate company in the de Havilland Enterprise for finishing-off various installations preparatory to the first flight. This was made on November 15th.

We have referred to the Trainer's direct parentage by the night-fighter Vampire, but the accouchement was conducted by Airspeed, Ltd. Given a mock-up of the night fighter from Hatfield, a section of the Airspeed design team at once got down to the job of modifying the D.H. 113 design to provide a wider cockpit with full dual control, dual instrumentation and side-by-side seats. (In the night fighter, as in the Mosquito, the seats are staggered.) During a conference at which Mr. R. E. Bishop, chief designer of de Havillands, and Mr. George Miles, chief designer of Airspeeds, were present, it was decided to go ahead with the project; very shortly after this, there arrived from Hatfield a Vampire night-fighter fuselage. Work was at once started on widening and deepening the canopy rails, letting in laminated longerons, and extending the lower part of the nose by the addition of ply laminations.

At shoulder level, the Trainer's cockpit is 44in wide—i.e., 6in wider than that of the Mosquito: it is therefore quite comfortably roomy.

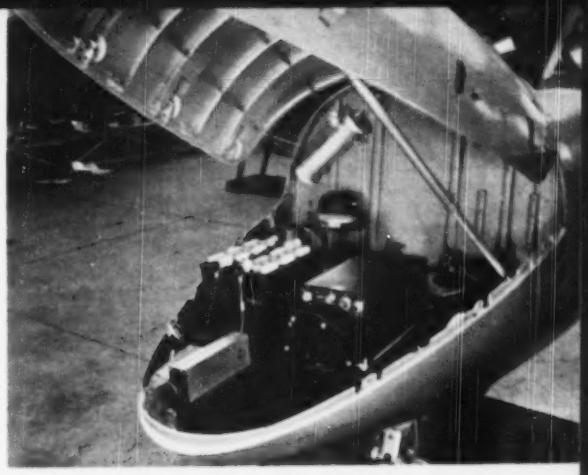


The cockpit and nose-profile changes aside, and with one or two detail exceptions, the Trainer can be regarded as a two-seat Vampire 5. It has the same wings and booms as the 5, but has a Goblin 3 power unit which differs from standard Vampire practice only in that the pressure for the cabin is tapped from the engine compressor instead of being supplied by a separate cabin supercharger: the differential is 2.75lb/sq in. There are also slight deviations in the tail surfaces, made necessary by virtue of the extended nose and, by the same token, these changes apply also to the D.H. 113 night fighter. They are as follows: the elevator trim tab has been increased in span (although the chord remains the same) to provide nearly 50 per cent greater area, the rudders have both been heightened so that they are of greater aspect ratio, whilst the tailplane tips have been extended so that they now project outboard of the fins. The increased nose area and the c.g. shift relative to the Vampire 5 make it understandable that some compensation would be necessary in the tail surfaces to counteract the consequent influences on directional and longitudinal stability. In the night fighter, the nose compartment, of course, houses the radar equipment, but in the Trainer this stowage volume is given over to radio, batteries, oxygen bottles and, in the extreme nose, a G.45 cine-gun camera: in the prototype, two four-channel V.H.F. sets are installed, but these are likely to be supplanted by a single ten-channel set in production aircraft.

With a cockpit which, at shoulder level, is 44in wide—i.e., an inch wider than that of the Airspeed Oxford, and 6in wider than that of the Mosquito—an entirely new form of canopy had to be devised. The framework is of welded tube, with glazing flats welded on, and on each side of the large, single-piece optically correct front screen are flanking direct-vision panels. The front screen is a four-ply Triplex unit, the two inner, ¼in-thick panels of which are fronted and backed by ⅛in-thick panels, all four being sandwiched with Vinal interlayers. In common with the remainder of the canopy, the direct-vision panels are glazed in Perspex, and are of a rearward-sliding type similar to those used on the Ambassador.

Access to the cockpit is provided through the roof panel, which, hinged at the rear centre-point, is locked by a pair of turnbuttons on each side, actuated from an internal lever mounted in the centre of the upper front-screen rail. A flush-retracting handle in the fairing at the rear of the hood is tied-in to the turnbutton linkage so that the hood can be opened from outside. For emergency jettison, a small hydraulic jack is embodied inside the hood, and connects into the external release-handle linkage to the turnbuttons. The jack is quite small, but is, nevertheless, amply sufficient to release the hood in flight—a job which, due to the increased friction on the turnbuttons as a result of the air load on the hood, might be beyond the power of a man's wrists even in the compelling circumstances of an emergency. Upon release, the leading-edge of the hood lifts somewhat, and when being jettisoned would be whipped back by air pressure and so break a shear point in the hinge.

In relation to the very short time taken to produce the prototype, the excellence of the Vampire Trainer's cockpit layout is most marked. We have seen all too many cockpits that have been the result of months of deliberation, but, even so, have still been mediocre. The Trainer, however, has a cockpit which actually looks inviting; it is admirably laid out, uncluttered and—perhaps the secret of its success—is absolutely straightforward. The seats are standard 25/40 g S.B.A.C. buckets, the centre of the pupil's seat being offset 10in to port of the fuselage centre-line, whilst that of the instructor's seat is offset 11in to starboard, this asymmetry—which is completely unobtrusive—being necessitated by the pupil's throttle-box and the elevator quadrant on the port side. Both seats are carried on horn-arms off lateral torque-tubes supported in extruded pillars, each seat being individually adjustable by a handle on the right-hand horn-arm, and located fore-and-aft by a pair of radius struts off the rear bulkhead. Behind and between the seats is a built-up box pillar carrying wing-tank jettison control, ground/flight master switch control, cabin pressurization control, and cabin temperature control.



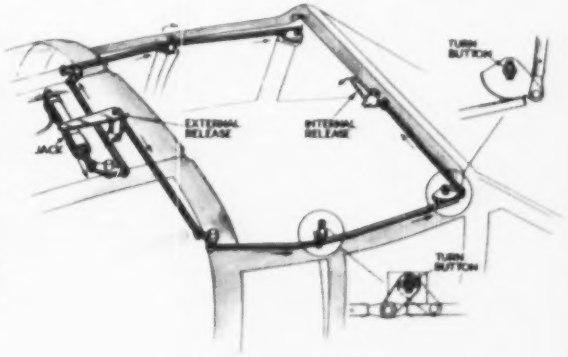
The alligator nose offers magnificent accessibility.

Wrist-action control columns are fitted. Instead of the spade-type grip used in the ordinary Vampire, the latest Dunlop moulded grip is used, and an extraordinarily neat and comfortable unit it is. The brake lever curves upward and outward from the base of the grip proper, and in the head of the grip are press-button and trigger-type switches for camera, guns, and bombs; R.P.s are fired by the gun button, after individual selection on a separate switch. For dual-control purposes, the control columns are linked by push/pull tubes to a bridging cross-tube behind the dome of the nosewheel well, which projects about 7in above floor level and runs back into the cockpit roughly to the front of the seats. Universal shafts extending rearward from the base of the columns carry sprockets for cross-linkage chains, and the port tube also carries cable anchor wheels from which the aileron cables run out to port, round Tufnol fairlead pulleys, and so, together with the elevator and rudder cables, rearward through a cast gland-box for pressure retention.

Rudder pedals of standard Vampire-Mosquito-Hornet type are hung from a pair of torque tubes bridging the cockpit, and although four feet have to be catered for, the spacing of the pedals is not too constricted. The pedal centres are, in fact, of the order of 14in, and pilots who fly the Trainer from either seat should be quite comfortable.

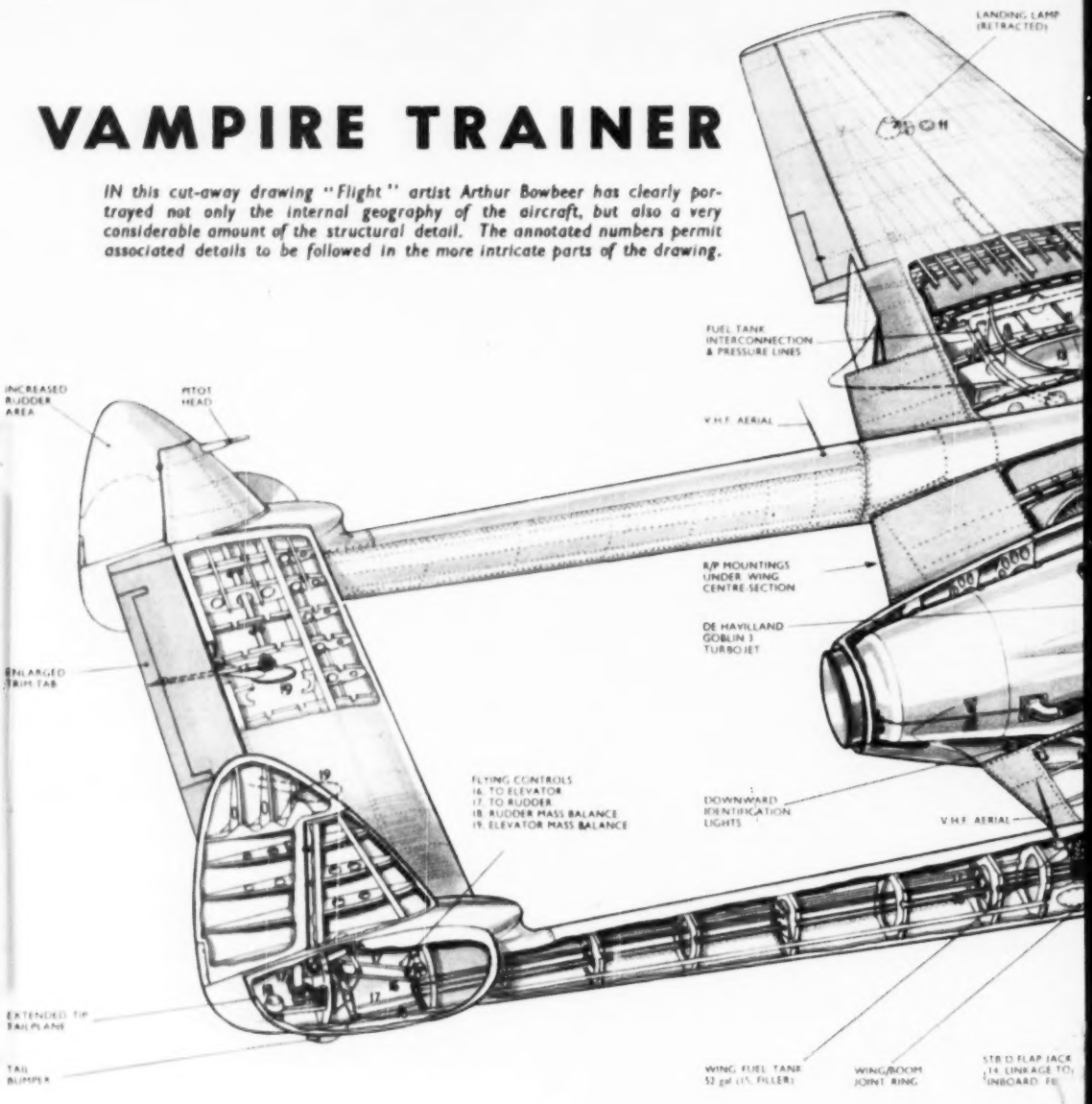
Interconnection of the engine, elevator trim and dive-brake controls is rather complex. The throttle, high-pressure and low-pressure cocks and the elevator trim control have an endless Teleflex system running back from the pupil's throttle-box to Teleflex pressure joints on the rear pressure bulkhead. Off one side of the throttle and elevator trim circuits, insert sections are taken in cable and

Detail of hood-locking system. The jack is purely for hood-jettison in an emergency when manual strength might be insufficient.

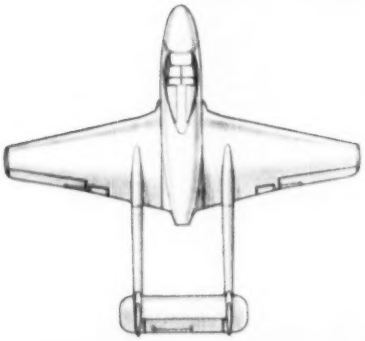


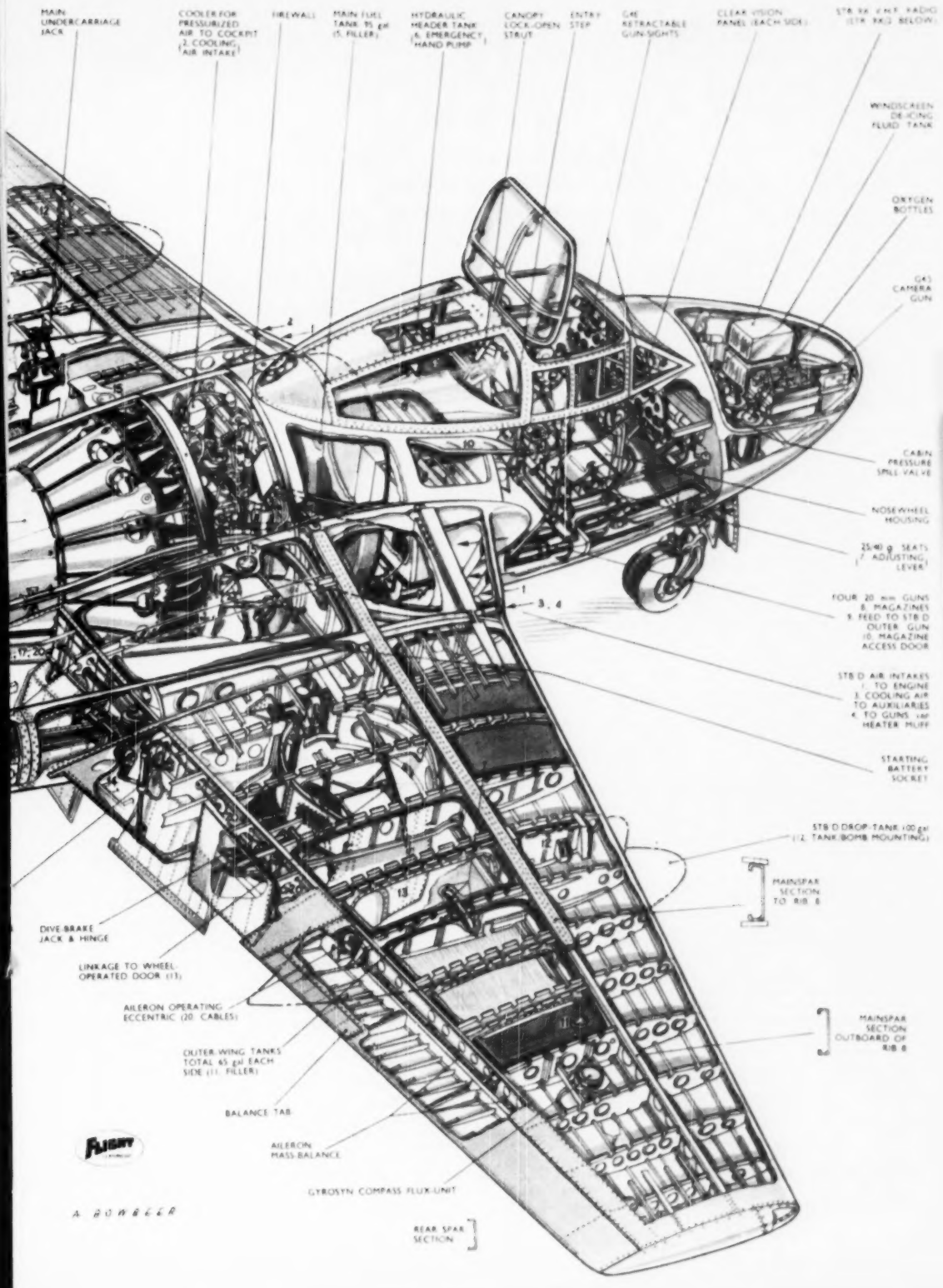
VAMPIRE TRAINER

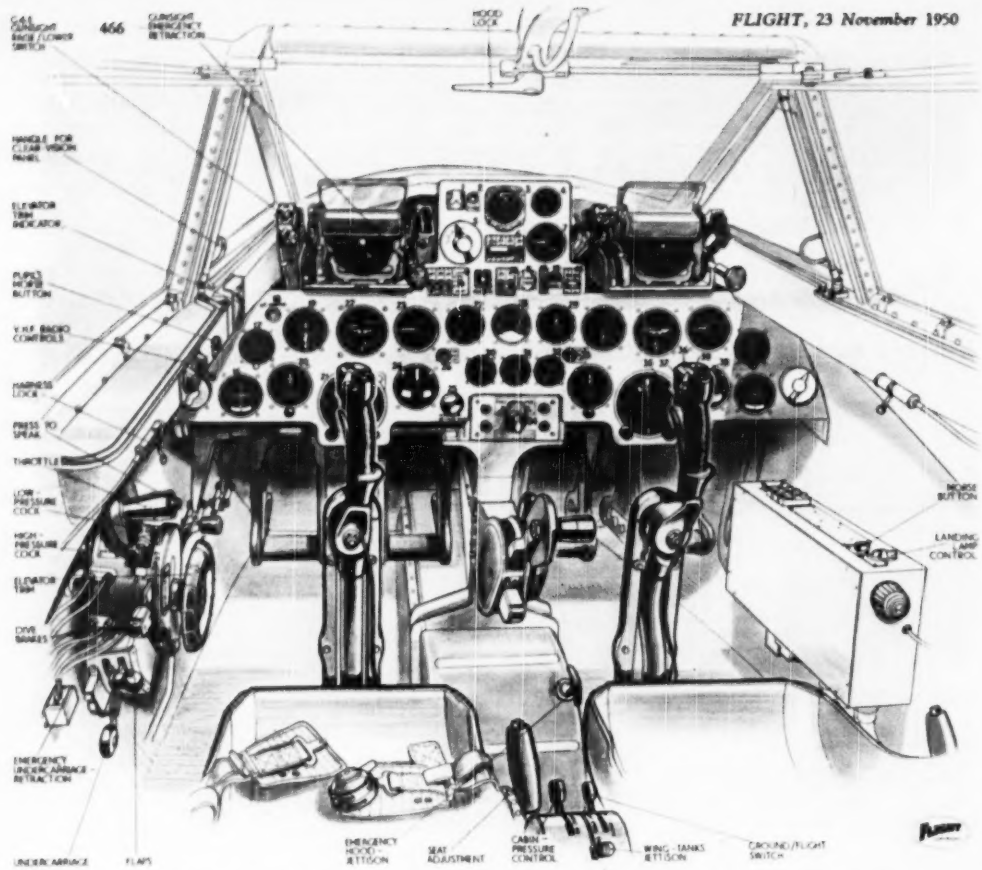
IN this cut-away drawing "Flight" artist Arthur Bowbeer has clearly portrayed not only the internal geography of the aircraft, but also a very considerable amount of the structural detail. The annotated numbers permit associated details to be followed in the more intricate parts of the drawing.



Length	... ...	34ft 5in
Span	... ...	38ft
Track	... ...	11ft 3in




MAIN UNDERCARRIAGE JACK
COOLER FOR PRESSURIZED AIR TO COCKPIT (2. COOLING AIR INTAKE)
FIREWALL
MAIN FUEL TANK 95 gal (5. FILLER)
HYDRAULIC HEADER TANK (6. EMERGENCY HAND PUMP)
CANOPY LOCK-OPEN STRUT
ENTRY STEP
GM RETRACTABLE GUN-SIGHTS
CLEAR VISION PANEL (EACH SIDE)
STB SX C.N.T. RADIO (ETR. RKT. BELOW)
WINDSCREEN DE-ICING FLUID TANK
OXYGEN BOTTLES
G45 CAMERA GUN
CABIN PRESSURE SPILL VALVE
NOSEWHEEL HOUSING
25/40 g SEATS (7. ADJUSTING LEVER)
FOUR 20 mm GUNS
8. MAGAZINES
9. FEED TO STB D OUTER GUN
10. MAGAZINE ACCESS DOOR
STB D AIR INTAKES
1. TO ENGINE
3. COOLING AIR TO AUXILIARIES
4. TO GUNS via HEATER MUFF
STARTING BATTERY SOCKET
STB D DROP TANK 100 gal (12. TANK/BOMB MOUNTING)
MAINSPAR SECTION TO RIB 8
DIVE BRAKE JACK & HINGE
LINKAGE TO WHEEL OPERATED DOOR (13)
AILERON OPERATING ECCENTRIC (20. CABLES)
OUTER WING TANKS TOTAL 65 gal EACH SIDE (11. FILLER)
BALANCE TAB
AILERON MASS BALANCE
GYROSYN COMPASS FLUX UNIT
REAR SPAR SECTION
MAINSPAR SECTION OUTBOARD OF RIB 8
A BOMBER



(1) Fire-suppression button; (2) Fire warning; (3) Machmeter; (4) Rear-bearing temperature; (5) Gunsight dimmer; (6) Left to right: Switches—start, master-compass, booster pump; (7) Brake pressure; (8) Left to right: Switches—Gunsight, pitot-head heat, navigation lights, downward identification lights; (9) Booster coil; (10) Pump-isolating, auxiliary start; (11) Starter button; (12) R.P. pairs/salvo; (13) Generator warning; (14) R.P. master selector; (15) Gunsight selector; (16) I.L.S. indicator; (17) Clock; (18) Undercarriage warning; (19) Air-speed indicator; (20) Altimeter; (21) Gyrosyn repeater; (22) Artificial horizon; (23) Rate of climb; (24) Turn-and-slip; (25) Windscreen de-icing pump; (26) Fuel-pressure warning; (27) Fuel contents; (28) Jet-pipe temperature; (29) Tachometer; (30) Flap position; (31) Undercarriage position; (32) Cabin pressure; (33) Cabin pressure warning; (34) Gyrosyn controller; (35) Gun-firing switch; (36) Guns—fire/safe; (37) Camera button; (38) Bomb button; (39) Bomb-button safety shroud; (40) Brakes.

This view of the cockpit from the pupil's seat makes clearly apparent the neatness and convenience of the whole layout.

VAMPIRE TRAINER . . .

chain down to a pair of co-axial torque tubes behind the pupil's seat. Leads from the instructor's throttle-box are taken down to the inboard end of these torque tubes. The dive-brake interconnection is made in a somewhat similar fashion, except that the whole transmission is by push-rods linking to a third (outermost) co-axial torque tube with take-off to a hydraulic selector valve which, together with those for undercarriage and flap control, is located at the base of the pressure bulkhead beneath the gland-box.

The primary flight-instruments are fully duplicated, and are embodied on a single panel spanning the cockpit, with the engine and auxiliary service instruments occupying the central area. A separate panel standing above the centre of the main board carries the engine and auxiliary service switches, a vacuum gauge and a machmeter, and is flanked by the Mark IVE gyro gun-sights in their M.L. Aviation retractable mountings. The blind-flying instrumentation differs from standard in that the A.S.I.s are of limiting-safe-speed type; G.IVB Gyrosyn compass repeaters do the duties both of compass and directional gyro; and I.L.S. indicators are embodied. The limiting-safe-speed A.S.I.s have a small window in the instrument face indicating the Mach number, and this is translated to an I.A.S. equivalent by a small needle sweeping a separate little scale at semi-radius. On installation, the instrument is set to the known limiting Mach number of the aircraft and, by virtue of the barometric compensation embodied, varies the indicated Mach number and its I.A.S. equivalent according to the obtaining conditions. So long as the main indicating needle does not move round to a value exceeding that of the smaller limiting-speed needle, the aircraft is flying within its safe speed range. The Gyrosyn compass installation has the master unit and variation-setting corrector tucked away behind the port seat, and a small control panel is mounted on a pedestal immediately forward of the instructor's throttle-box. As already mentioned, each pilot has a repeater indicator, and the central knob of the control panel can be turned to select port or starboard indicators alternative to the central "off" position. With the "off" position selected, each of the indicators acts as a normal slow-rate directional gyro, but when one or other is selected on the central control knob, that unit is compass-monitored and becomes, in fact, the ordinary Gyrosyn unit, whilst its fellow remains as a directional gyro indicator. Each indicator is provided with a "lining-up" knob and a setting knob, the former for lining-up the gyro according to the magnetic heading, when the instrument is being used as

PROGRESS

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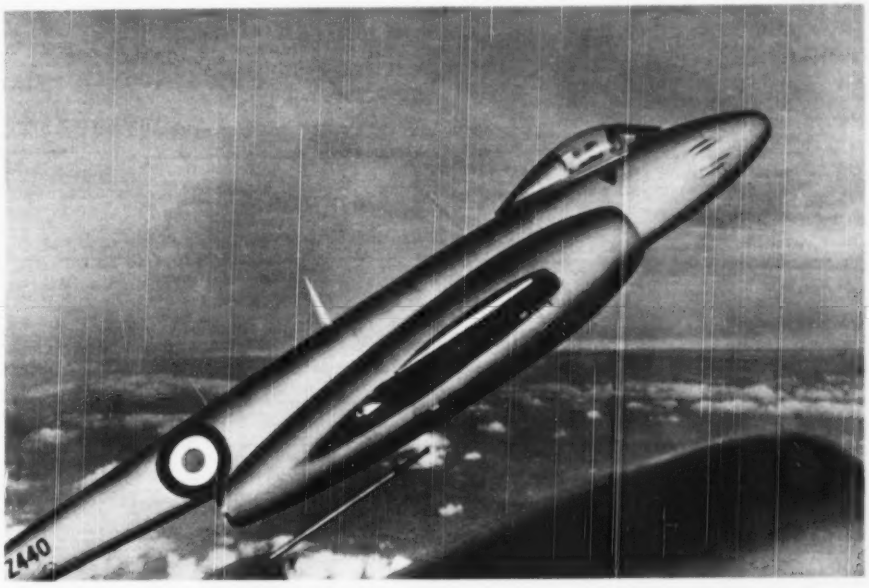

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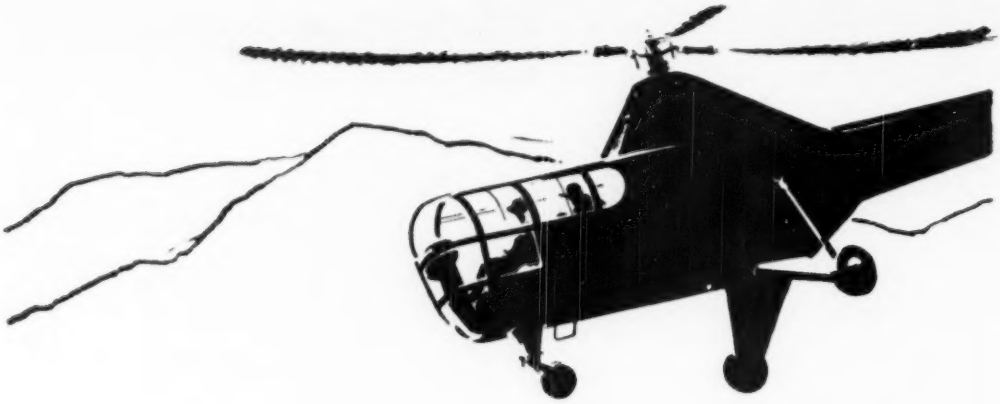
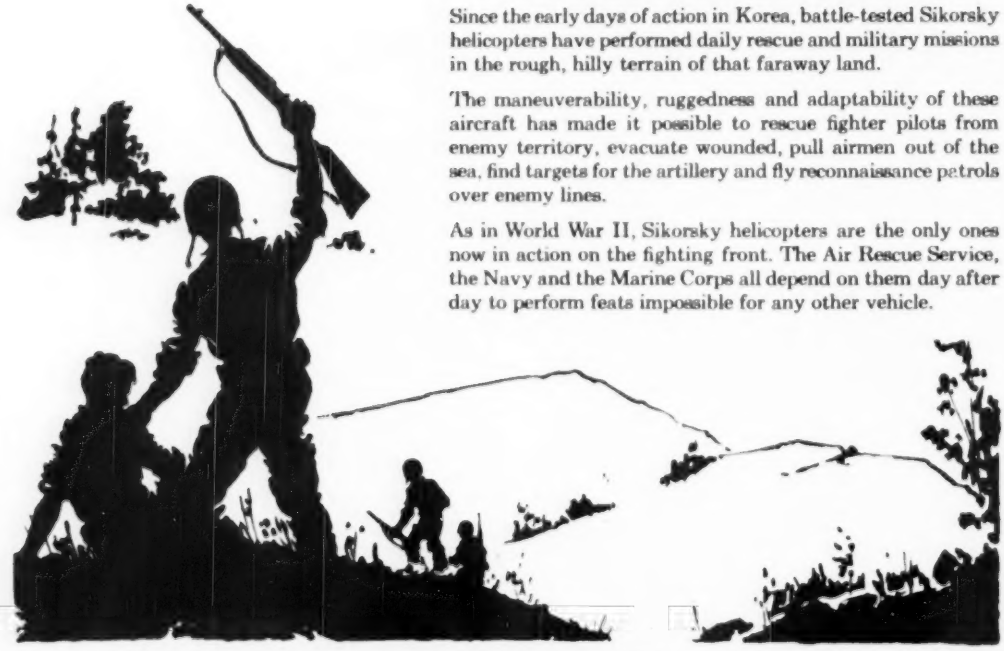


SIKORSKY HELICOPTERS
at the front in Korea

Since the early days of action in Korea, battle-tested Sikorsky helicopters have performed daily rescue and military missions in the rough, hilly terrain of that faraway land.

The maneuverability, ruggedness and adaptability of these aircraft has made it possible to rescue fighter pilots from enemy territory, evacuate wounded, pull airmen out of the sea, find targets for the artillery and fly reconnaissance patrols over enemy lines.

As in World War II, Sikorsky helicopters are the only ones now in action on the fighting front. The Air Rescue Service, the Navy and the Marine Corps all depend on them day after day to perform feats impossible for any other vehicle.



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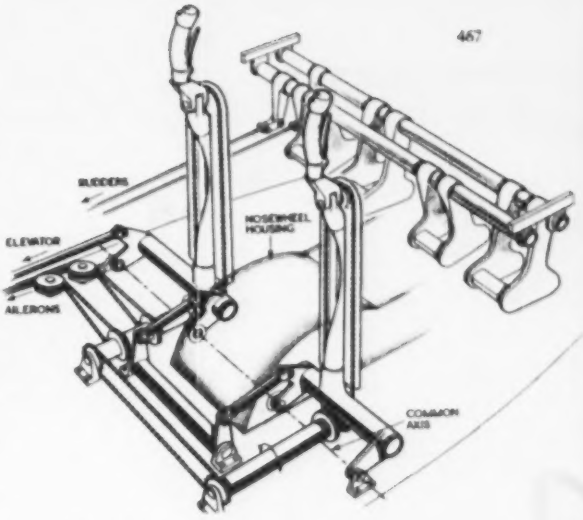
VAMPIRE TRAINER . . .

a Gyrosyn, whilst the setting knob is employed only when the instrument is functioning as a normal directional gyro.

Each gyro gun-sight can be used independently of the other, the master control is within the reach of each pilot, and each sight has its individual selector switch; the range control is conventionally embodied on each throttle. On the left-hand side of each mounting is a switch for raising or lowering the sight, and a red emergency knob at the lower right of each mounting is provided so that, if an electrical failure occurs with the sight extended, a wire is snapped and the sight automatically retracted.

It is difficult to assess an aspect of fighter-pilot training which is more important than gunnery, in which term, of course, must be included R.P. and/or bomb attacks, and in this regard, the side-by-side pupil/instructor relationship afforded by the Vampire Trainer is nothing less than ideal. The use of standard Vampire 5 wings enables the Trainer to carry the eight rockets or two 1,000-lb bombs of the Mark 5, in addition to the fuselage armament of four 20 mm Hispano cannon, each with 150 rounds. Thus, not only does the aircraft provide training potential matched precisely to the operational ability of the single-seat Vampire fighter-bomber but, if necessary, in an emergency, the Trainer can be immediately used in full-blooded operational roles. At the present time there is a distressing lack of training aircraft in which gunnery instruction can be given to pilots at high speed and, even more important, at high altitude. The Vampire Trainer should fulfil this vital requirement admirably, for its stability limitations at its operational ceiling should be in no wise inferior to those of the Vampire 5.

De Havillands refer to the 115 as an "all-purpose" jet trainer, and they are not overstating the case. In addition to training in gun-, rocket-, and bomb-sighting, air combat and fighter navigation, which are implicit in the layout and equipment of the aircraft, the Trainer is also eminently suitable for employment as an advanced trainer, and for the ever increasingly important work of jet conversion. So straightforward and docile are the flying characteristics that it was seriously suggested to us that the trainee pilot might well go straight on to the Vampire Trainer from an *ab initio* type such as the Chipmunk or Prentice. Another and, we should think, extremely valuable use for the new aircraft, will be deck-landing training —all that is needed is the fitting of catapult and arrester hooks and retention tongue. For the young pilot being initiated into the difficult art of deck-landing, we can visualize no more comforting and confidence-instilling arrangement than to be able to essay the venture with an old hand sitting by one's side. To some extent, the same thing applies to initiation into the forbidding realms of compressibility. The excellent control characteristics throughout its speed range for which the Vampire is world-famous means that the handling of the Trainer at high Mach numbers well suits it to this employment. Curiously, despite the large flat area of the front screen, the Trainer has a greater maximum speed at the higher altitudes than has the single-seat Vampire: these, of course, are estimated figures, but the design people concerned have a reputation for conservative estimation, and justify the increased maximum on the grounds that the fuselage has a better fineness-ratio.



Detail of dual control articulation and cross-linkage.

In brief, the performance of the Vampire Trainer can be summarized as follows: The operational ceiling of 40,000ft can be reached in 16.3 minutes, and when the aircraft is fitted with two 100-gallon drop tanks, the operational ceiling is reduced to 34,000ft, which can be reached in 17.5 min. The maximum level speed is 467 kt at sea-level, and 452 kt at 40,000ft.

At a Mach number of 0.7, at 40,000ft (395 kt), the radius of steady turn is 1.95 nautical miles. At the same speed and altitude, the aircraft can achieve a minimum radius of turn of 0.95 n.m. At lower altitudes, these figures will naturally be considerably improved.

The endurance at altitude with allowances for take-off, climb and descent, is approximately two hours without drop tanks and three hours with. Without drop tanks, the aircraft has a still-air range of 730 n.m. at 30,000ft, and 345 n.m. at sea-level. With drop tanks, the corresponding figures are 1,080 n.m. and 540 n.m.

For practice ground-attack duty with eight 25-lb R.P.s, a practical radius of action of 100 n.m. at 5,000ft can be achieved, whilst leaving an ample fuel margin at the end of the flight. Without external equipment, the limiting Mach number at high altitudes is nearly 0.8 and, without drop tanks, 0.7. The maximum true level speed of which the Vampire Trainer is capable (without external equipment) is 477 kt at 20,000ft, this being equivalent to a Mach number of 0.775. C. B. B-W.

TESTING SUPERSONIC AIRSCREWS

THAT supersonic airscrews are receiving a good deal of consideration in the U.S.A. is implicit in the announcement that the world's first supersonic-airscrew spin-pit will be in operation early in 1951 at the Aeroproducts division of the General Motors Corporation, Dayton, Ohio. The pit takes the form of a steel cylinder of 12ft 10in diameter, 7ft 10in high, which is sunk below ground level with an airtight seal to a concrete base, and a steel-dome roof.

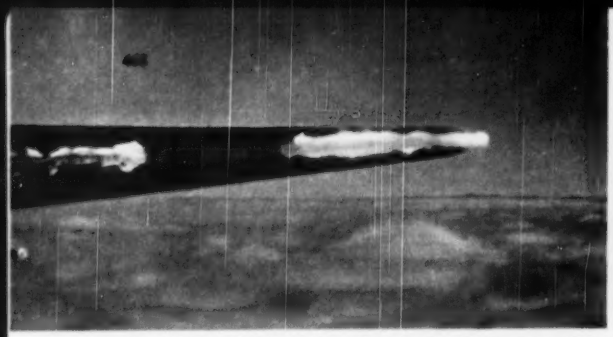
By evacuating the chamber down to 0.01 atmosphere (i.e., 99 per cent vacuum) an engine of only 450 h.p. is sufficient to rotate test airscrews at relatively high r.p.m. The test specimen is rotated in a horizontal plane, by means of a vertical drive-shaft through the dome from a right-angled gearbox.

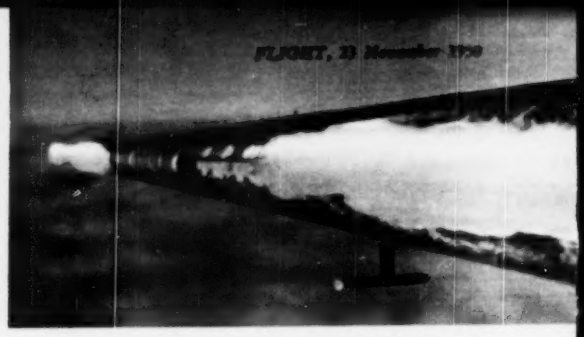
It appears that tapered blades of very thin section form the basis of present Aeroproducts studies. Illustrations of comparative sections at a 20in-radius show the supersonic blade to have a t/c ratio of about 4.83 per cent, by comparison with a t/c of 22.55 per cent for a conventional subsonic blade.

EARLY WARNING OF ENGINE FAULTS

A NEW-TYPE instrument known as an engine-performance indicator has been developed by the Consolidated-Vultee Aircraft Corporation, its purpose being to give advance warning of impending engine failure. Comprising a compact detector unit, linkage, and an indicator dial for the cockpit, it is installed adjacent to the carburettor, where it performs a function described as "measuring the distances to right or left to which the engine is displaced when the airscrew is rotating."

The cockpit unit is basically a voltmeter graduated in b.h.p., and the accuracy of the indication is said to be greater than that of any device of this kind previously developed. Should the engine show signs of rough running or power loss prior to a failure, the needle on the gauge immediately oscillates and a warning light glows on the panel, thus giving the engineer time to check operation and, if need be, feather before serious damage occurs. (It is often difficult at present to detect an incipient failure in time to save the engine from complete destruction with, in extreme cases, loss of the airscrew and reduction gear.)





These photographs of the port and starboard tailplanes of the Viking in which the B.E.A. de-icing flight trials were conducted clearly demonstrate the effectiveness of the Porosint panel distributors as against the standard strip-type distributors (immediately inboard) and also indicate, by the ice accretion on the unprotected outer portions of the leading edges, the severity of the icing conditions encountered.

ECONOMICAL DE-ICING

Results of a B.E.A. Investigation of the Porosint Fluid-distributor

THE advent of both the surface-combustion heater and the gas turbine has provided two heat-sources of considerable attraction for de-icing purposes, so it is not surprising that thermal anti-icing has lately tended to overshadow the erstwhile standard methods of protection by chemical and mechanical means. Nevertheless, thermal systems are not light, and all share the necessity for incorporating the distributive ducting in the aerofoil leading edges as an inherent part of the structure. (It is not practicable to apply a thermal system to an existing structure; at the very least, the whole of the leading edge would need to be rebuilt in a considerably modified form.)

This does not apply to the latest development in the well-known chemical system established by T.K.S. (Aircraft De-Icing), Ltd. A new sintered-bronze known at Porosint has made possible not only the protection of wings and tail surfaces without severe structural modification but, in addition, has shown an efficiency better than twice that of the existing strip-insert-type distributor. Porosint is made by Sintered Products, Ltd., for T.K.S., and an extraordinary material it is; seemingly smooth both in appearance and to the touch, it has, in fact, millions of tiny pores through which the special "Kilfrost" de-icing fluid can exude. With panels of the porous material fitted along the leading edges, the prevention of dangerous ice-accretion is simply a matter of switching on the pump which delivers the fluid to the panels.

Between January 3rd and March 7th this year, a series of 27 separate icing-investigation flight-trials was undertaken by British European Airways with a Viking aircraft manned by Captain D. Mason, 1st/Off. Kuttelwascher, and R/Off. Crisp (flight crew), Mr. H. J. Jauncey (B.E.A.), and Messrs. D. G. Thorpe and J. H. Andrews (T.K.S.). Two independent observers, Mr. J. R. Leach (Vickers-Armstrongs) and Mr. R. Burdett (Air Registration Board) were also carried on the majority of flights. The main objects of the tests were to determine the minimum flow-rate which would prevent a serious build-up of ice in known icing conditions; to determine the correct technique for the satisfactory operation of the T.K.S. strip-insert distributors as normally fitted to Viking aircraft; and to test the new T.K.S. Porosint panel distributor in natural icing conditions.

How well these objects were achieved is made apparent in the comprehensive and valuable report of the flight trials issued by B.E.A. The report is certainly valuable to B.E.A., for it shows that a reduction of some £8,000 per annum can be effected in the operating costs of the present fleet of aircraft. It also implies that a considerable weight-saving—346 lb per aircraft—becomes available for revenue-producing payload. These advantages are a direct result of the reduction in fluid-flows as determined by the flight trials. T.K.S. themselves had long been of the opinion that the rates of flow ordinarily used were wasteful, and this belief the results of the flight trials amply confirmed. Whereas the previous recommendation was for 1 pint/hr/sq ft of frontal area to the wings and 2 pints/hr/sq ft for the tail surfaces, the report recommends that these rates should be reduced to 0.66 pint/hr/sq ft both to the wings and tail surfaces. In each case, the frontal area is measured at the maximum thickness of the aerofoil section.

Spectacular as these savings are, even greater savings would be achieved by the use of Porosint panels in place of the existing standard strip-insert distributors. It is stated in the B.E.A. report that the Porosint panel gives "equal if not slightly better results on half the flow-rate of the standard distributor." The reason is that only sufficient fluid to maintain a wet surface is necessary: any excess pumped out achieves no visible improvement and is wasted.

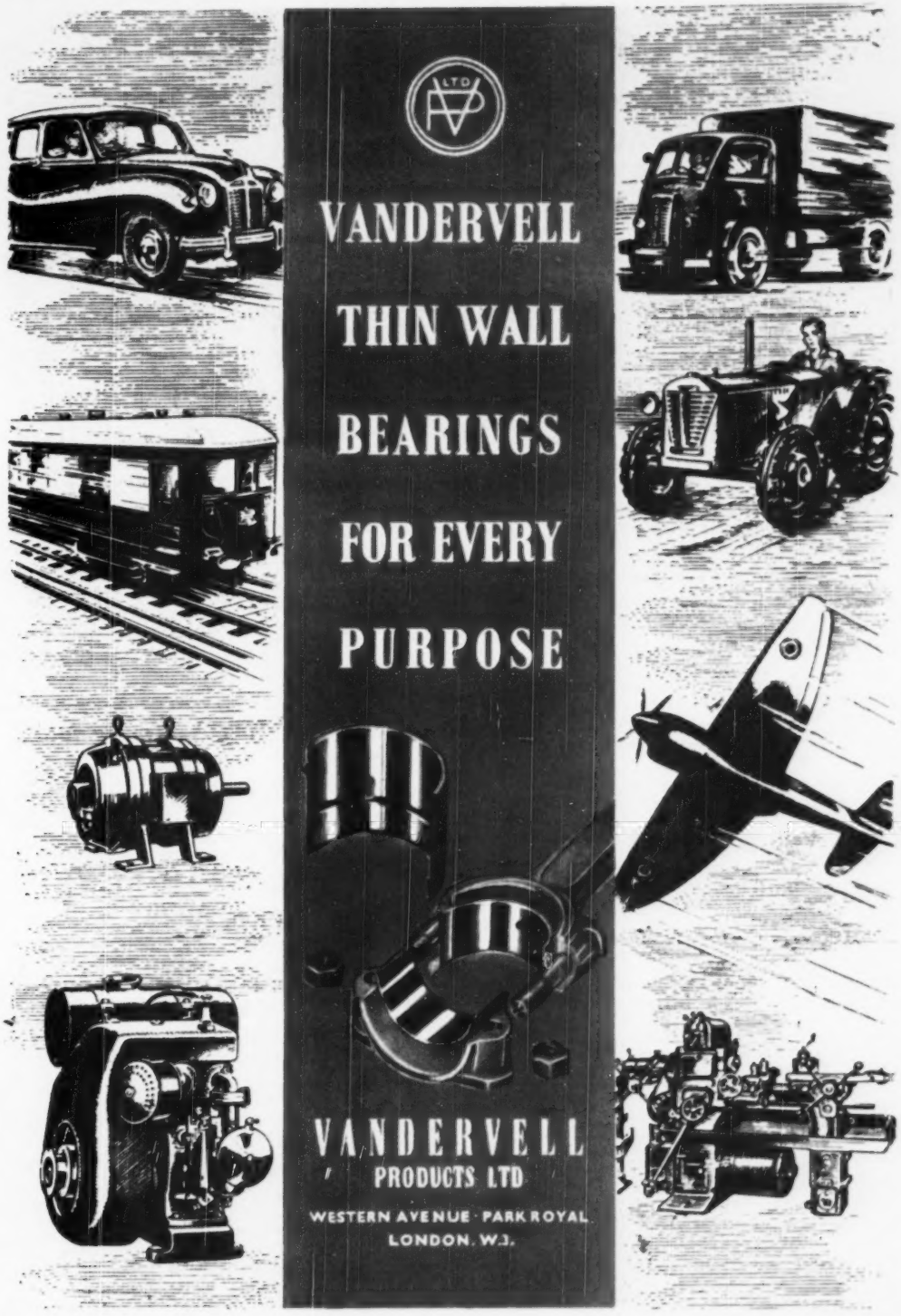
The action of the fluid is to destroy the bond of the ice and thus facilitate its removal by the airflow. It was established during the flight trials that, with the Porosint panel distributors, in certain conditions (usually between zero deg C and −3 deg C), the de-icing power of the liquid is sufficient to prevent entirely any ice-accretion. In conditions of low-temperature rime-icing it is, perhaps, more common for a de-icing cycle to establish itself. When this happens, the first icing droplets penetrate the protective film of liquid and become partially lodged. The subsequent layers which bond externally then act as a protection against further dilution of the fluid, and the resulting concentration at the interface rapidly destroys the adhesion of the ice, which then becomes detached and is blown off.

Porosint offers such little resistance to fluid-flow—its porosity is approximately 35 per cent—that to permit efficient pumping it is necessary to have some restriction interposed in the fluid-feed system. This necessity is turned to good account by providing a mat of bronze strips placed between the Porosint and the corrugated backing-plate: fluid is pumped through the plate, the corrugations of which act as distributor channels, whence the fluid can seep through the very fine channels formed in the bronze-strip mat and so reach the rear surface of the Porosint.

Construction

Each panel is fabricated by spot-welding the components together. The partial solidification at the spot-welds has practically no adverse effect, for the welds are very small, and even if a relatively large area of the panel were not fed with fluid—for example, as a result of local blockage—the capillary action inherent in Porosint would result in seepage of the fluid across the blocked area from the surrounding wet areas.

In that it is necessary only just to exceed the range of stagnation movement in order to provide full icing protection, there has so far been no need to make Porosint panels in widths greater than 6in; widths up to 12in could, however, be provided if required. Individual Porosint panels are 12in long and are made up in 6ft group-lengths which are adequately fed by a single input pipe. With a total thickness of 0.11in, the addition of Porosint panels to a leading edge involves no aerodynamic penalty, and the method of fixture, by marginal strips, is simplicity itself. Alternatively, the panels can readily be embodied as an integral part of the leading-edge structure during the building of the surface, and thereby maintain fidelity of the design contour whilst involving virtually no structural complication. On the score of physical strength, Porosint is tough, despite its extraordinary properties, and its life is not likely to be materially less than that of the aerofoil surface it serves. Maintenance costs are an extremely important factor to the airline operator, and in this regard Porosint panel distributors show up exceedingly well, for they should require negligible attention.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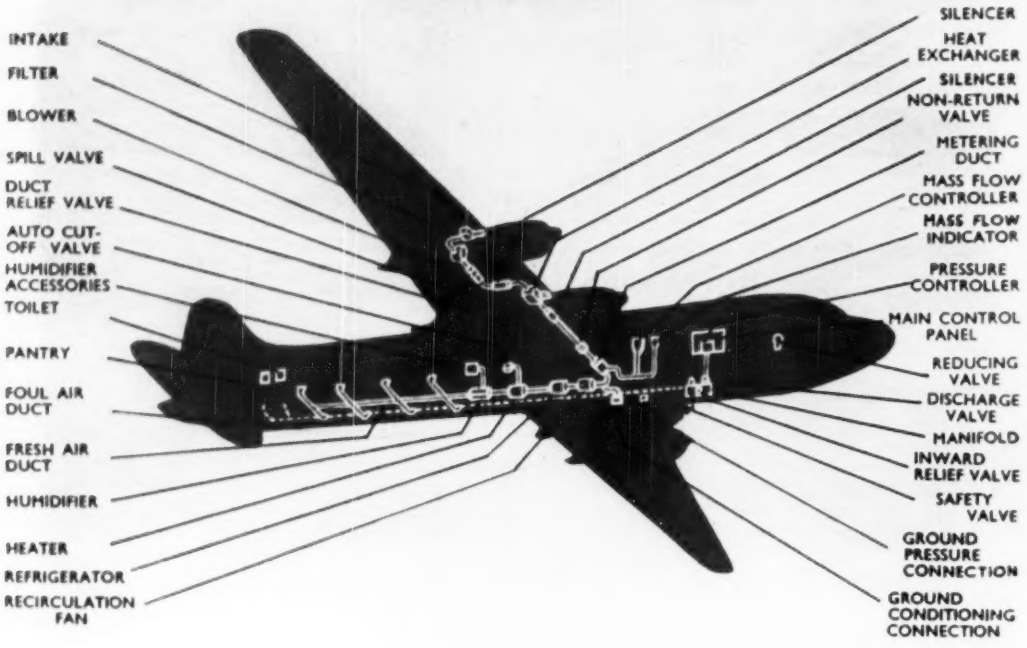
CABIN ATMOSPHERE CONTROL



The system of a typical air liner, fully equipped for Cabin Atmosphere control, is represented above.

By presetting a simple selector, cabin pressure can be controlled from take off so that the cabin climbs to a maximum of 8,000 feet during the time the aircraft climbs to its maximum operating altitude. The internal rate of change, also capable of selection, is normally equal to a rate of climb of 300 feet per minute. Lesser cabin heights can be established at will for intermediate cruising altitudes, and cabin height can be varied in flight. Once a given cabin altitude is established it is maintained automatically irrespective of aircraft manoeuvre. An automatic device prevents the maximum permitted differential pressure being exceeded.

Flow control units maintain a constant air supply irrespective of variations in ambient pressure, or engine speed. Temperature and humidity control units ensure comfortable and safe cabin conditioning.

Complete safety, under all conditions, is assured by the incorporation of such items as safety valves, duct relief valves, non-return valves, etc.

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YEOVIL ENGLAND

DESIGNERS AND MANUFACTURERS OF AIR CONTROL EQUIPMENT

CIVIL AVIATION NEWS

WHERE WEST MEETS EAST: This striking study of the terminal building at Farouk Airport, Cairo, seen from beneath the wing of a B.O.A.C. Hermes IV, is the work of Mr. Harry Hensser, B.O.A.C.'s chief photographer. Several other fine views taken on the same flight—to the opening of Livingstone Airport—appeared in "Flight" of September 21st and 28th.

FOR FARMERS ONLY?

REPLYING to questions in the House of Commons last week, the Postmaster-General, Mr. Ness Edwards, said he regretted that it had not been found practicable to make any frequency available for the Airmet service. He revealed, however, that some "amplification of the B.B.C. weather forecasts" was about to be introduced.

He was further asked if the possibility of obtaining a wavelength on the 49-metre band, or of using some of the Russian wavelengths (in view of that country's infringement of the international-frequencies agreement) had been considered. Mr. Ness Edwards replied that he would first like to see the result of the new weather broadcasts. If they proved unsatisfactory the question might be raised again.

The new amplified broadcasts began last Sunday and consisted of two minutes of more detailed local information broadcast by regional transmitters. Though undeniably a slight improvement on previous broadcasts, and useful to farmers and others whose activities are of a local nature, the new service cannot be regarded as an acceptable substitute for Airmet.

ATLANTIC CARGO COMPETITION?

PROPOSALS by two American airlines to introduce transatlantic cargo services to London and Glasgow, among other European terminals, are being considered by the C.A.B. The companies concerned are Trans-Ocean Airlines and Seaboard and Western Air, both of which normally operate as irregular carriers in the United States but have, on occasions, undertaken transatlantic charter flights.

Their present plans are for large-scale, cheap cargo flights from the United States to Europe and the Middle East with a frequency according to traffic demand. The C.A.B. is not expected to reach a decision on the applications for several weeks, but it is learned that the Board's examiner considers that the proposed services would not be economical and would possibly harm the regular airlines already serving these areas.

K.L.M.'s REPLACEMENT PLANS

AN announcement was made last Friday by K.L.M. that they intend to replace ten American four-engined aircraft now in service by five new Douglas DC-6Bs and a similar number of L-1049 Super Constellations. The announcement says that for the time being K.L.M. does not consider the acquisition of jet powered transport to be commercially justified.

The Skymasters and Constellation L-749s to be replaced will have completed five years' service by 1952 and 1953 respectively. The new equipment is expected to arrive in 1952 or early in 1953.

The company points out that both the DC-6B and the Super Constellation are designed for eventual conversion to turboprop power and, being pressurized, can operate successfully at 25,000ft, which is considered an economical altitude for power units of this type.

UNLUCKY AMBASSADOR

WHILE landing at Christchurch in gusty conditions from a test flight on November 13th, the third prototype Airspeed Ambassador suffered an extremely heavy landing. For test purposes the load application was placed unusually far forward, and although the undercarriage was able to save the main structure, the stresses imposed—being in excess of the normal strength requirements of the engine mountings—caused both power plants to drop out. The aircraft bounced, touched down again farther along the runway minus its engines and eventually stopped.

The Ambassador was in the hands of Ron Clear, accompanied by a test crew. This prototype was actually the first "production" version. Twenty more Ambassadors are reported to be well advaiced on the assembly lines at the manufacturers' Christchurch factory.

B.E.A. AND THE "INDEPENDENTS"

AS reported in last week's issue of *Flight*, meetings have recently taken place between B.E.A. and the British charter operators to review the arrangements for scheduled services operated under Associate agreements in this country.

Certain statements attributed to the charter companies are thought by B.E.A. to be "misleading" and wishing to clarify the present position and to prevent any further misunderstanding the Corporation has issued a new statement. This points out that the original meeting was called in order that private operators might be informed of plans for the next five years. It was felt that this information would permit them to plan their operations on a more economical basis and would permit a closer integration of services. An Association, based on the

CIVIL AVIATION NEWS . . .

ideals of I.A.T.A., to provide unified travel documentation was also suggested at this meeting.

Private operators were invited to submit their proposals for future services. Ninety-four such applications were subsequently received, of which the Corporation was prepared to recommend 74 to the Air Transport Advisory Council and a further six in modified form. The remaining 14 were considered as being either in direct competition with existing services or were to the Continent, where international difficulties would have been involved.

The statement emphasizes that the only service which B.E.A. proposes to take over during next year is that between Manchester and the Isle of Man, which is operated jointly by North-West and Sivewright Airways. This service, it is stated, is in any case being run under a short-contract agreement, as it has been B.E.A.'s intention to return to it at an early date. Thus, maintains the Corporation, it is untrue to say that services operated by Lancashire Aircraft Corporation have been forced to close down because of B.E.A.'s intention of absorbing its routes. None of these services is due to be taken over before 1952.

The allegation that the Channel Islands charter companies are being forced to withdraw from the Islands is also alleged to be incorrect; B.E.A. says that, on the contrary, it is prepared to welcome charter operations to the Channel Islands as feeder services to its own routes. The policy for 1951 does not in any way affect the companies now based in the Channel Islands.

The statement concludes by saying that B.E.A. feels that with security of tenure being offered for known periods over certain routes, operators are being offered "unprecedented opportunity for closer work with the Corporation to the mutual benefit of both parties."

"Serious consideration has also been given to the suggestion that charter companies should operate in parallel with B.E.A. on certain routes to the Isle of Man and the Channel Islands."

From the viewpoint of the charter operators, the proposed new list of Associate Services is claimed by the B.A.C.A. to prohibit any consideration of re-equipping charter fleets, even for those routes which may be available for the full five years. It is thought "most unfair" that the Corporation should, in spite of its rights under the Civil Aviation Act, seek to return to routes which it has operated in the past and discarded, but which have now been publicized and developed by the independent companies. It is claimed that the new structure would prevent them from operating an economic route-pattern.

B.A.C.A. feels that the charter operators must be relieved of the increasing obligations of wages and conditions within the civil air transport industry, must enjoy more freedom, or must have some form of official support.

Certainly the recent announcement of the formation of R. Aux. A.F. transport squadrons within the charter organizations points to the potential national value of the independent companies. The continued struggle for existence which many operators are still enduring can only have the effect of discouraging the healthy development of our internal air transport and of preventing us from deriving the maximum advantage from a powerful "merchant air force."

It daily becomes more apparent that some suitable arrangement must quickly be made which, even if in certain individual cases it entails "the axe," will prove in the long run to have been justified in the national interest.

SECOND ALPINE ACCIDENT

FOR the second time within ten days an airliner has been involved in a serious accident while attempting to cross the Alps. On the evening of November 13th a DC-4 belonging to a Canadian charter company, Curtiss Reid Aviation, Ltd., and engaged on a charter flight from Rome to Paris en route for Montreal, struck the 8,300ft peak of Mount Obiou, near Grenoble, while flying through snow and mist. There were no survivors among the 58 persons on board. The crew were all British, and the aircraft was commanded by Capt. Holmstead. Most of the passengers were Canadian pilgrims returning from a Holy Year celebration in Rome. The London insurance market was interested in the insurance of the DC-4, which was valued at £175,000.

Until this accident Curtiss Reid Aviation, Ltd., who normally confined themselves to domestic charter services in Canada, had operated for 22 years without a fatality.

LIGHT-AIRCRAFT LIMITATIONS

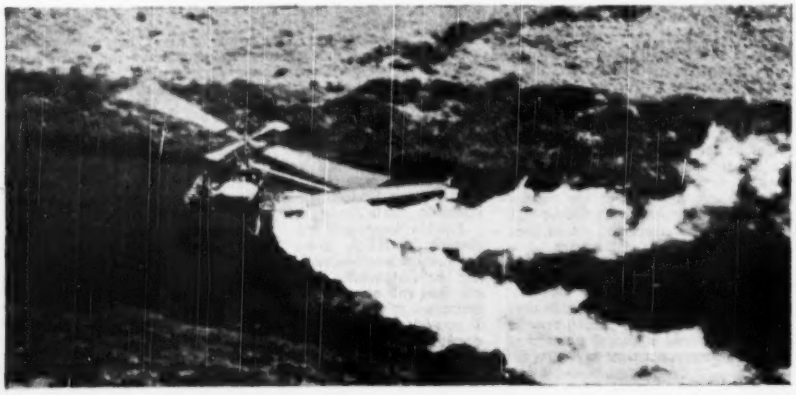
IN *Information Circular No. 108/1950* the M.C.A. draws attention to the number of accidents which, involving light aircraft, appear to have been largely due to pilots' failures to assess prevailing circumstances before attempting to take off. The circular stresses the need for pilots to be completely familiar with take-off procedure (especially the correct use of flaps) for the particular aircraft they intend to fly, and to ensure that the aircraft is loaded correctly, so that prescribed weights and c.g. limits are not exceeded.

It is pointed out that, when operating from confined spaces, pilots should use discretion in relating published performance data to available take-off lengths and heights of nearby obstructions, as take-off distances are sometimes figures which can be achieved only by flying the aircraft to its limits under favourable conditions. In this connection, the Ministry has already issued Limited Performance schedules for types commonly used commercially as well as privately (such as the Proctor and the Gemini), giving full information on take-off and climb performance at maximum weights. Later it is hoped to include the effects of the principal variable factors.

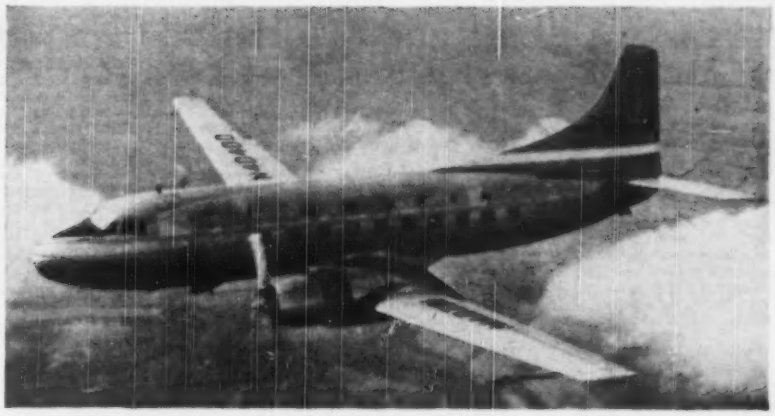
A rough guide to the effect of local factors, such as gradients, soft and rough surfaces, long grass, high temperatures and down-draughts in the lee of trees, buildings and ground undulations, is contained in the Circular. It is stressed that if more than one adverse factor is present, the overall effect will be progressively cumulative and, therefore, greater than the sum of the estimated individual factors.

The major effects are, briefly, (a) take-off distance increases by approximately 7 per cent for each 1,000ft a.s.l.; (b) each degree Centigrade rise above standard air temperature (i.e., 15 deg C at sea level minus 2 deg C for every 1,000ft a.s.l.) increases take-off distance by approximately 1 per cent; (c) an uphill gradient of 1 in 60 increases take-off distance by 10 per cent or even more where the airfield surface is concave; (d) a dry, short turf surface increases the distance by some 10 per cent over that for dry concrete, while soft turf or long grass may lengthen the take-off run by up to 50 per cent.

Variations in wind speed and direction make it advisable not to credit more than 50 per cent of the reported or estimated figure. A head wind of 10 kt decreases distance to unstick, while a 15 kt wind lessens it by 35 per cent. It should also be noted that the effect of reducing all-up weight by 2 per cent is to lessen take-off distance by 5 per cent.



LOW-LEVEL STRIKE: Some of the most objectionable and dangerous pests—the mosquito in its larval form is an example—are found not upon leaves or roots, but in water. The helicopter is well suited for attacking them in their native element by dusting or spraying, as this picture from America shows. The aircraft is a Hiller 360.



SHORT-HAUL SPECIALIST. The first prototype of the Martin 4-0-4, an improved and slightly longer version of the 2-0-2, made its first flight last month. Characterized by higher payload capacity and greater comfort for passengers, the 4-0-4 has a top speed of 312 m.p.h.

BREVITIES

THE Minister of Civil Aviation, Lord Pakenham, visited Ringway Airport (Manchester) on November 10th and inspected the new extensions to the runways. He said that negotiations now being conducted between the M.C.A. and Manchester Corporation for the taking-over of the airport were proceeding satisfactorily.

* * *

A plan to provide an international airport at Paya Lebar, a north-eastern suburb of Singapore, has been submitted to the Singapore Legislative Council; the cost is estimated at £2,353,000.

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Mr. J. Roland Adams, K.C., has been appointed by the Minister of Civil Aviation to hold a public Court of Inquiry into the accident to the B.E.A. Dakota G-AGIW at Mill Hill on October 17th.

* * *

As a result of negotiations between the Peruvian State Airport Corporation and Panagra, which has operated to that country for 22 years, the first I.L.S. system in South America is soon to be provided at Lima Airport.

* * *

The Nantes airport at Chateau-Bougon, which has hitherto served only as a daylight landing field for French aircraft, now has night-landing facilities. It is hoped that the airfield will provide a useful diversion for any pilots who find themselves in difficulties while flying over the west of France.

* * *

I.A.T.A. announces that, with effect from November 15th, fares on the transatlantic services of Air France, B.O.A.C., K.L.M. and T.C.A. from Montreal and Gander are reduced by approximately 6 per cent. This follows the re-valuation of the Canadian dollar. The reduction will not be effective elsewhere in North America, where fares are paid in U.S. dollars.

BAHAMAS VISITORS: At a party given by the Bahamas Development Board on the occasion of the pre-inaugural flight of B.O.A.C.'s new Nassau to New York service are Sir Miles Thomas, Capt. O. P. Jones (in command of the Stratocruiser) and Sir Frank Whittle, the Corporation's Adviser on Jet Development.

* * *

According to figures published by the C.A.A., Cleveland heads the list of American "terminal-type" airports for traffic handled in the first half of this year. Cleveland's total was 125,000 movements; Chicago was second with 113,000, followed by Miami, St. Louis and Oakland. A noticeable increase was reported in charter traffic.

* * *

A further step towards the development of a heliport in Birmingham is revealed by the announcement—made at a meeting between representatives of B.E.A. and the Municipal Corporation—that experimental helicopter landings will be made within the next six months on a ground site in the centre of the city.

* * *

With the approval by the C.A.A. of voice communication between Pan American aircraft and ground stations on the Basra-Karachi-New Delhi portion of the P.A.W.A. Far Eastern network, the provision of a round-the-world R/T link for the company's aircraft is now complete. The project has cost some $2,000,000.

* * *

There are suggestions in the United States that the Avro Jetliner may be the first transport of its type to be tested under the provisions of the new Prototype Aircraft Testing Bill. During the hearing in connection with this legislation it was definitely established that no provision of the Bill would prevent the Jetliner from being tested with part of the $12,500,000 authorized by Congress. Several airlines have indicated their interest in trial operations with non-passenger schedules.

* * *

In the first nine months of this year T.W.A. achieved a substantial reduction in operating cost while increasing the total volume of business to produce a net income of $5,067,471 (approximately £1,809,811). Announcing these figures, the company states that the addition of all-cargo four-engined aircraft on trans-continental domestic services since November 1st is expected to result in a heavier contribution to revenue from freight operations within the next quarter. The cost per ton-mile was decreased by 9.4 per cent from last year's figure, while revenue ton-mileage rose by 11.6 per cent.

* * *

The Parliamentary Secretary to the M.C.A., Mr. Frank Beswick, said in reply to recent questions in the House of Commons that experiments to find a cheaper form of Fido had so far indicated that an efficient fog-dispersal system using high-pressure fuel oil was "almost certainly a technical possibility." The results of the trials were being awaited before deciding whether the cost of a full-scale installation (about £250,000) was justified. In the meantime the M.C.A. was obtaining the views of operators on the use of FIDO as an alternative to the existing practice of aircraft diversion. Mr. Beswick also said that during the time that the FIDO installation was available at Blackbushe (about 15 months) it was called for only once. FIDO facilities were now confined to Manston.

CLUB and GLIDING NEWS

WITH the object of finding ways in which instruction might be speeded up, the instructors of the Surrey Gliding Club (based at Redhill) recently carried out a "post mortem" on the year's flying. Among their conclusions there may well be some valuable pointers for members of the gliding fraternity in general.

By charting pupils' progress it was discovered that the number of launches required before a solo tended to be fairly high—an average of about 50. The instructors consider that three possible reasons for this fact are: (1) inefficient instruction; (2) pupil incompetence; (3) the setting of too high a standard before the solo-stage is reached. Enlarging on these points, the Club considers it essential that, provided they get along well together, a pupil should, wherever practicable, remain with the same instructor throughout his training. Pupils, it thinks, should also make an effort to ensure that their training is continuous, or at least regular, in the early stages. This would reduce the number of launches before solo and, therefore, the total cost of the training period.

It is pointed out that, in dual training, there is a tendency for the pupil to rely too much on his instructor; once he has reached the circuit stage he should take upon himself the responsibility for the flight and make the necessary decisions involved, just as though he were alone in the aircraft.

It is thought that where a club has an over-large membership, it is a mistake to rush through a long "Daisy list" in order to get everyone airborne. Each pupil on elementary training should be given three consecutive launches, regardless of how many students are still waiting. All concerned should also co-operate in stepping up the number of launches per day.

As far as standards of competence are concerned, the Club points out that, as in its own case, a high level is particularly desirable where the gliding club shares a field with other flying organizations.

The Surrey Gliding Club, incidentally, is holding its Christmas party on December 9th, starting at 6.30 p.m., and it is hoped that members of many other clubs will attend. Tickets, price 7s 6d, may be obtained from the chairman of the House Committee, Surrey Gliding Club, Redhill Airfield, Surrey.

WORLD-BEATER? At the end of this month F/L. "Jock" Forbes, who is in charge of the R.A.F. Gliding Instructors' School at Detling, will visit the United States to make an attempt on the world's gliding altitude record, which now stands at 35,500ft. The attempt will be made with an American sailplane in the Sierra Nevada mountain area of California, where, given good soaring conditions, F/L. Forbes is confident that he will reach 40,000ft.

* * *

ON the initiative of the Kemsley Flying Trust, an investigation is to be made into the operation and cost of flying ultra-light aircraft, and arrangements have been made for the first production Motor Tutor to be taken over by the Southend Flying School. The Ultra Light Aircraft Association is supporting the plan, and a proposal that the School should also conduct comparative trials with a Dart Kitten has been accepted.

The two aircraft will be flown intensively in the normal school curriculum, and will be used to enable pupils to acquire cheaply the experience necessary to obtain their licences. A full report of the investigation will be published by the Trust in due course.

The manager of Southend Municipal Airport, Mr. Bernard Collins, who is among the most experienced ultra-light pilots in this country, extends an invitation to all U.L.A.A. members to visit Southend Airport, where they will be able to fly both the Motor Tutor and the Dart Kitten at a rate of 30s per hour. Application should be made personally to Mr. Collins.

* * *

IN our issue of November 9th it was stated that Mr. E. B. Weston had been elected chairman of the newly formed Christchurch Aero Club. The chairman is, in fact, Mr. K. R. Scales, who previously acted in the same capacity for the former South Hants Ultra-Light Aero Club; Mr. Weston is hon. secretary and treasurer.

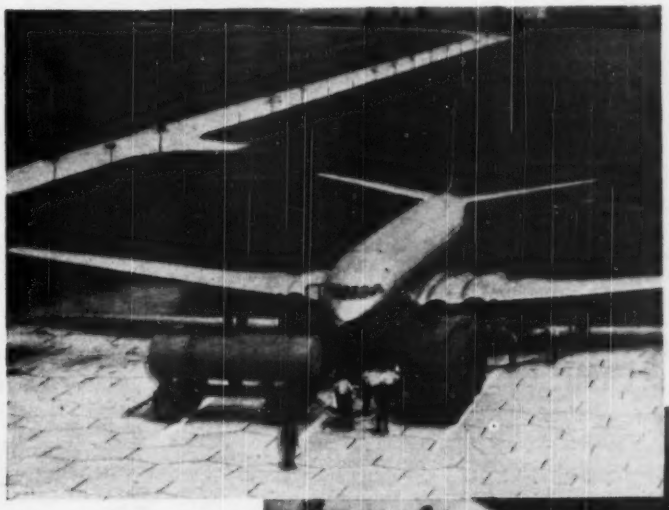
R.Ae.C. AVIATORS' CERTIFICATES

BELOW is a further list of R.Ae.C. Aviators' Certificates covering the period from July 14th to August 15th, 1950. The previous list (June 26th-July 14th) appeared in *Flight* last week, and we hope to publish further names in an early issue.

No.	Name	Club or School	Date
26,614	Archibald David Hepburn Milne-Home	Qualified Service pilot	14.7.50
26,615	John William Barling	Qualified Service pilot	14.7.50
26,616	Michael Richard Blakeway	Hampshire Aeroplane Club	14.7.50
26,617	Michael Charles Russell	Qualified Service pilot	14.7.50
26,618	Jack August Bridger	Qualified Service pilot	14.7.50
26,619	Donald William Livsey Fairbank	Brough Flying Club	17.7.50
26,620	Victor John Dalton	Denham Flying Club	17.7.50
26,621	Robert Francis Browning	Marshall's Flying Club	17.7.50
26,622	Edward Charles Martin Stewart	Qualified Service pilot	18.7.50
26,623	Kenneth Thomas Bromley	Qualified Service pilot	18.7.50
26,624	Alfric Ronald Cawthorne	24 R.F.S., Rochester	18.7.50
26,625	Philip James Colbourne	24 R.F.S., Rochester	18.7.50
26,626	David White	24 R.F.S., Rochester	18.7.50
26,627	Thomas John Methven	24 R.F.S., Rochester	18.7.50
26,628	John James Turner	Service Pilot u/t	19.7.50
26,629	Kenneth Frederick John Humphreys	Service pilot u/t.	19.7.50
26,630	Peter Duncumb	Service pilot u/t.	19.7.50
26,631	Geoffrey Ratcliff Green	Qualified Service pilot	19.7.50
26,632	Geoffrey Keith Burrill	Darlington and Dist. A.C.	19.7.50
26,633	Jack Simler	Southend Municipal F.S.	19.7.50
26,634	Harold Jackson Parkinson	Blackpool and Fylde A.C.	19.7.50
26,635	John Stafford Loomes	Qualified Service pilot	25.7.50
26,636	Bryan Gait	Qualified Service pilot	25.7.50
26,637	John Pamell Elliott	West London Aero Club	25.7.50
26,638	Robert Bruce Cole	Qualified Service pilot	26.7.50
26,639	Douglas James Thornson	Airways Aero Club	26.7.50
26,640	Henry Douglas Robb	Airways Aero Club	26.7.50
26,641	Peter George Evans	Service pilot u/t.	27.7.50
26,642	Brian William West	Herts and Essex A.C.	28.7.50
26,643	Edmund Arthur James Taylor	Hampshire Aero Club	28.7.50
26,644	John Finlay Kirkpatrick	Qualified Service pilot	31.7.50
26,645	Robert John Herbert Saunders	Qualified Service Pilot	31.7.50
26,646	John Jackson	Lancashire Aero Club	1.8.50
26,647	Arthur William Clifton	Liverpool Flying Club	2.8.50
26,648	Malcolm Clow Wilson	College of Aeronautics	3.8.50
26,649	Graham Hargrave Mann	R.N. Flying Club	4.8.50
26,650	John Maurice Ayre	Qualified Service pilot	8.8.50
26,651	Harry Rollins	Qualified Service pilot	8.8.50
26,652	Percival George Lord	Qualified Service pilot	8.8.50
26,653	John Edward Blackman	Service Pilot u/t.	8.8.50
26,654	Dudley Charles Bottoms	London Aeroplane Club	9.8.50
26,655	John Philip Edwards	London Aeroplane Club	9.8.50
26,656	John Michael Greenland	London Aeroplane Club	9.8.50
26,657	George Brian Vaughton	Midland Aero Club	9.8.50
26,658	Frederick Ronald William Peasley	Qualified Service pilot	9.8.50
26,659	David George Reed	Airways Aero Club	10.8.50
26,660	Percy William Scotney	Cambridge Aero Club	12.8.50
26,661	Henry Portal	Qualified Service pilot	12.8.50
26,622	Omar Baidas	Redhill Flying Club	12.8.50
26,663	John Goodwin Burns	Qualified Service pilot	12.8.50
26,664	Alfred John Hall	Wolverhampton Aero Club	12.8.50
26,665	Michael Sean Armstrong	Qualified Service pilot	12.8.50
26,666	Alan Morgan Bassett	Qualified Service pilot	12.8.50
26,667	Peter Alexander Black	Qualified Service pilot	12.8.50
26,668	Maurice Egglishaw Bewick	Qualified Service pilot	12.8.50
26,669	Ian Miles Clifford	Qualified Service pilot	12.8.50
26,670	Archibald William Forster	Qualified Service pilot	12.8.50
26,671	Kannoch Anderson Haining	Qualified Service pilot	12.8.50
26,672	John Edward Nethaway	Qualified Service pilot	12.8.50
26,673	Eric Irvin Pennington	Qualified Service pilot	12.8.50
26,674	Ian Dudley Shaw	Qualified Service pilot	12.8.50
26,675	Maurice Albert Turner	Qualified Service pilot	12.8.50
26,676	Rowland Mark Ware	Qualified Service pilot	12.8.50
26,677	Gordon Roy Wilkinson	Qualified Service pilot	12.8.50
26,678	Ernest Veitch	Qualified Service pilot	12.8.50
26,679	John Drennan	Qualified Service pilot	15.8.50
26,670	Leonard Horchkin	Qualified Service pilot	15.8.50

PRESSURE REFUELLING THE COMET

6,000 Gallons in 20 minutes



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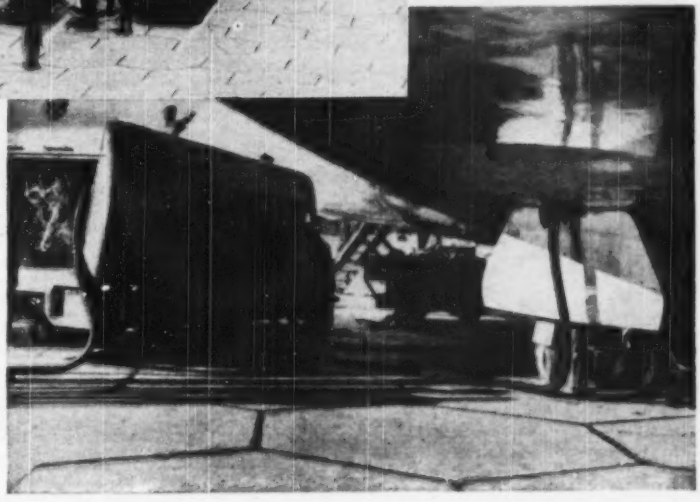

On all Pressure Refuelling questions consult the specialists — F.R. — the pioneers of high-pressure refuelling systems and the leading manufacturers of aircraft refuelling equipment, including Valves, Float Switches, Couplings, Connectors, etc. Comprehensive facilities are available for conducting full-scale mock-up tests of aircraft fuel installations and fuelling tests of prototype aircraft.

FR

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5

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A NEW STICK-FORCE UNIT

Compact Design, with Apparent Advantages, Developed by U.S. Bureau of Standards

DURING the past few years, the importance of the ability to measure aircraft control-input force—colloquially known as "stick-force"—demanded of a pilot in all circumstances of flight has advanced as a direct corollary of the advance in aircraft performance. Understandably, the means devised for measuring stick-forces have been many and varied.

An extremely neat stick-force unit has, however, recently been developed for the U.S. Navy Department by F. Cordero and S. H. J. Womack, of the U.S. National Bureau of Standards. Its merits are that it is compact, easily attached to the control column, requires little attention, is unaffected by the ordinary fluctuations of aircraft battery voltages, is of adequate sensitivity, and permits the taking of a photographic record of stick-force indications.

The standard hand-grip of the control column is replaced by the stick-force unit incorporating a cantilever-spring sensitive element, the deflection of which is measured in two perpendicular directions for elevator control, aileron control, and combinations of both. The spring deflections control electric voltages, operating a dual pointer selsyn indicator.

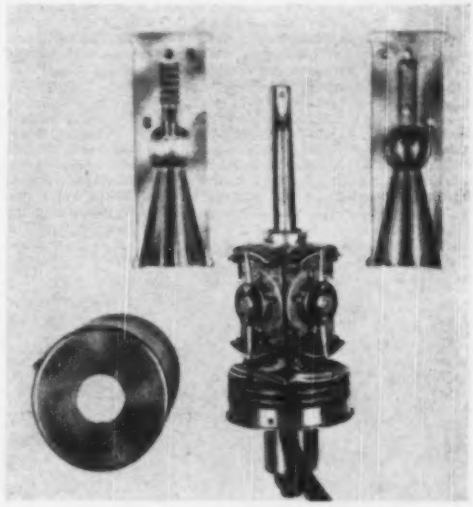
Left: The neat design of the device, the linear-scale force-indicator and their comparative sizes are here apparent.

Right. With the cover removed and the hand-grip bisected, the internal arrangement of the unit is made clear.

The cantilever spring takes the form of a vertical rod of circular cross-section, the lower end of which is rigidly anchored in the base of the unit. At the top of the rod is a sphere about which is clamped the cylindrical hand-grip, thus effectively localizing the application of force by the pilot essentially at one point. Flexure of the rod is then a measure of the transverse force exerted through the handle with application at the spherical joint.

When the rod is bent by the application of a force at the handle, it deflects one or both of two flat spring strips mounted vertically beside the rod; anchored at their bases, they are free at their upper ends to swing out with it as it bends. The strips are so mounted that one is deflected by motion of the rod at right angles to that which deflects the other. Outward or inward motion of either of the strips moves a lever attached to the shaft of the appropriate selsyn transmitter. The voltage produced is transmitted to one or both of the complementary D.C. selsyn indicators, which show motion in the two perpendicular directions. Both indicators are housed in one case having a single 360-deg scale graduated directly in pounds of force. A second dual indicator may be connected in parallel with the first for duplicate indication. Since the deflection of the spring rod is proportional to the force applied to the handle, and since the rotation of the brushes is nearly linear with respect to the rod deflection, a force indicator with an essentially linear scale can be used.

When no force is being exerted on the hand-grip, it is kept co-axial with the vertical rod by means of a coil-spring and plunger in a cylindrical cavity within the hand-grip just above the sphere to which the hand-grip is clamped. The hand-grip is only bearing-tight about the sphere, which is screwed to the top of the rod. When the hand-grip is displaced, the compressed spring forces the plunger down against the flattened crown of the sphere and so tends to return the handle to the neutral position.



The instrument is designed to measure a maximum force of 200 lb in each of the two perpendicular systems separately, or a maximum of approximately 140 lb in both systems simultaneously. A D.C. voltage between 22 and 28 is required, with a current of 50 milliamperes at 28 volts. An eight-wire cable connects the transmitter and indicator units. The circuit includes two 100-ohm protective resistors and four 7,500-ohm rheostat segments obtained from ordinary potentiometers, as well as four pairs of silver brushes and four contact bars of silver wire. The entire equipment, exclusive of electrical leads, weighs about 3 lb.

The instrument is calibrated by hanging weights from the handle held in a horizontal position. By changing the length of the lever operating the brush shaft, the calibration may be adjusted within a reasonably broad range. A special screw, slider, and drum are provided for making this adjustment, which may be quite conveniently performed.

Tests of a typical instrument, it is stated, show a maximum hysteresis of the order of 2 per cent of full-scale value; thus, the uncertainty in reading is about 1 per cent of the full-scale range. The calibration curve deviates about 2 per cent from linearity, and the sensitivity is of the order of 0.5 per cent of the full scale.

LIGHT WORKSHOP EQUIPMENT

ALTHOUGH intended primarily for the home craftsman and for "the man whose business does not justify the use of costly industrial tools," the "Handy Utility" equipment recently produced by Black and Decker, Ltd., Harmondsworth, Middlesex, has many applications.

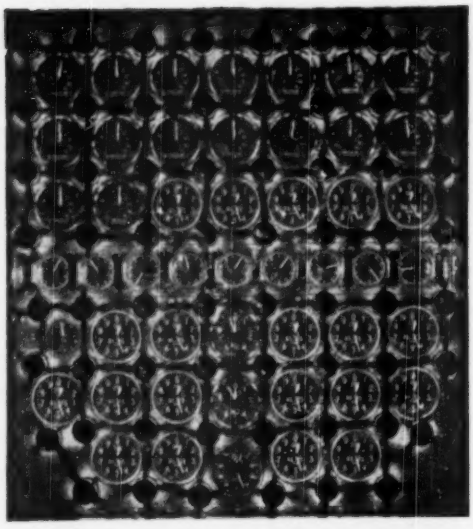
Basically, it consists of a sturdy electric drill with a capacity of ¼in in mild steel, and with it are supplied a horizontal stand, 13 high-speed drill bits, 3in grinding wheel, 4in wire brush, 3in cotton buff, wheel arbor, and tube of polishing and buffing compound. These items may be acquired separately, or as a complete kit in a metal case at £10 17s 6d.

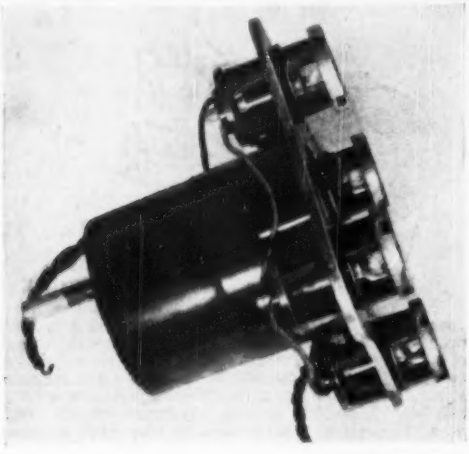
WITHOUT REFLECTION

A Practical Method of Lighting Instruments for Photographic Recording

ONE of the problems incident upon the use of automatic observers in the flight-testing of modern aircraft has been that of illuminating the instruments economically, and without reflection from the instrument glasses. A new method of illuminating the instrument panel, evolved by Mr. P. D. Betteridge, of the Hawker Aircraft experimental department, has produced excellent results.

The problem first occurred when it became necessary to photograph 39 air-speed indicators used for measuring pressures, together with ten selsyn indicators for indicating control-surface angles. It had been noted that, when air-speed indicators were grouped together, there was always a space at the corners, and this space was sufficient to allow a ¼in diameter hole to be drilled through the panel, so permitting the fitting of a specially designed light unit. This unit consists of a Bakelite moulding which holds a 12-volt six-watt M.E.S. bulb, and the bulbs are series-wired in pairs to run off the aircraft 24-volt supply. The cap which shields each bulb from the camera is pressed from 22 s.w.g. aluminium sheet, and great care has been taken in design to ensure that the caps cannot come off accidentally.





This photograph of an automatic-observer test panel demonstrates the admirable illumination and non-reflecting qualities of the new light units. (Left) Side view of air-speed indicator, showing how the new Hawker lighting unit is fitted through the panel at each of the four corners of the instrument.

As may be seen from the photograph of a large automatic-observer panel, the light units (which, incidentally, weigh ½oz each) are fitted in each corner formed by four instruments, and all the way round the outside of the group; thus, every instrument is evenly illuminated. Mounting the light-sources so close to the instrument dials has the immediate advantage that less power is required and, even more important, that reflection from the glasses into the camera lens is impossible. Another special light unit devised for use with selsyn indicators consists of a Bakelite moulding which houses 12-volt six-watt festoon lamps, and is fixed with the same screws as the instruments; these units weigh but ½oz each.

ROCKETRY

MR. A. V. CLEAVER, A.R.Ae.S., who is in charge of the de Havilland Engine Company's work on rockets, is this evening presenting a paper entitled *Rockets and Assisted Take-Off* before the Royal Aeronautical Society. After outlining the essentials of the rocket motor, the paper goes on to deal with various forms of propellant, and the practical problems of rocket design and development. Some space is devoted to general engineering problems, and a broad survey is made of the various applications of rockets to assisting take-off, ending with a comparison with other methods of performing this function.

£40,000 FOR BLACKBURN EX-DIRECTORS

IN the 1949-50 report of Blackburn and General Aircraft, Ltd., provision is made for the sum of £40,000 to be paid to former directors "in settlement of all claims in respect of the termination of their service agreements or otherwise." It will be recalled that at the conclusion of the recent controversy on the management of the company it was announced that "settlement satisfactory to all parties had been reached."

Reviewing future prospects in the report, Mr. Robert Blackburn warns shareholders that a drastic reduction in profits is inevitable, though he feels that the company's position is sufficiently strong to withstand a temporary setback.

FORTHCOMING EVENTS

Nov.	23.	R.Ae.S.: "Rockets and Assisted Take-off," by A. V. Cleaver, A.R.Ae.S.
Nov.	25.	Helicopter Association: "Helicopter Piloting," by J. S. Fay.
Nov.	28.	R.Ae.S. Section Lecture: "Metal Adhesive Processes," by F. H. Parker.
Nov.	29.	R.Ae.S. (Weybridge): Film Show.
Nov.	30.	R.Ae.S. Graduates: "High-speed Flying," by S.L. John Darry, D.F.C.
Dec.	1.	London Aeroplane Club: Annual Party.
Dec.	5.	Inscitute of Transport (Graduates and Students): "Passengers by Air," by D. O. Bustard.
Dec.	6.	R.Ae.S. (Brough): Members' Lecturettes and Film Show.
Dec.	7.	Ariel Club (Air Ministry and M.C.A. Social and Athletic Association): Annual Ball.
Dec.	7.	R.Ae.S.: "Relative Merits of Centrifugal and Axial Compressors"—Discussion between Dr. E. S. Moult, B.Sc., M.I.Mech.E., F.R.Ae.S., and H. Pearson, B.A., A.F.R.Ae.S.
Dec.	8.	R.Ae.S. (Preston): Annual Dance.
Dec.	9.	Surrey Gliding Club: Christmas Party.
Dec.	12.	R.Ae.S. (Belfast): "Boundary Layers at High Speeds," by Prof. A. D. Young, M.A., A.F.R.Ae.S.
Dec.	13.	R.Ae.S. (Preston): "Rocket Propulsion and Interplanetary Flight," by A. V. Cleaver, A.R.Ae.S.
Dec.	13.	R.Ae.S. (Weybridge): "Designing for High Speed," by Professor E. J. Richards, M.A., B.Sc., F.R.Ae.S.
Dec.	13.	Herts and Essex Aero Club: Annual Dinner and Dance.
Dec.	14.	R.Ae.C.: Film Show, Londonderry House.
Dec.	22.	West Ridin: Aviation Centre: Annual Dinner and Dance.
Dec.	29.	R.Ae.S. (Weybridge): Annual Dance.
Jan.	10.	R.Ae.S. (Brough): "High-speed Flight," by H. Davies, M.Sc., F.R.Ae.S.

O.U.A.S. CELEBRATES

University Squadron's Annual Dinner : Presentation to C.G.I.

WHEN the annual dinner of the Oxford University Air Squadron was held at the Randolph Hotel, Oxford, last Friday, November 17th, it marked a singular event—the 25th anniversary of Mr. J. B. Acres' service with the Squadron. The Commanding Officer, W/C. C. N. Foxley Norris, in a memorable speech, referred to the invaluable service Jack Acres, as chief ground instructor, had given to the unit; and the C.-in-C., Reserve Command, Air Marshal Sir Robert Foster, presented Mr. Acres with an inscribed salver as a token of the Squadron's appreciation.

The C.O., who is leaving on January 2nd to take up an appointment at the R.A.F. Staff College, stated that though during the past year the Squadron had done more flying than any other University squadron, the number of its members embarking on a Royal Air Force career was still too small. During the three years of his command, the figures had risen (1948-two; 1949-three; 1950-eleven), but eleven was only 25 per cent of Squadron annual strength. He thought that perhaps their National Service experience before they came up might have had something to do with the way members felt, but that views commonly formed in such circumstances were likely to be wide of the mark. As far as security in a career was concerned, the R.A.F. now offered as much, perhaps, as did any other career—unless a man intended to become a dentist.

The Very Reverend Dr. Lowe, Dean of Christ Church and Vice-Chancellor, said that the reputation of the Squadron within the University was extraordinarily high, and this applied not only within the University: he had been surprised at the importance accorded to University air squadrons by the Air Ministry. They were regarded as nuclei of a *corps d'elite* in the Service. The Vice-Chancellor ended his speech with the words "the future is yours."

Deputizing for the Chief of the Air Staff, who was unwell, Air Marshal Sir Robert Foster, having made the presentation to Mr. Acres, then presented to the Squadron Adjutant, for "record purposes," a photograph of W/C. Foxley Norris taken during his visit to America, and illustrating Anglo-American friendship in no uncertain manner. Sir Robert referred to Dr. Lowe's use of a helicopter earlier in the year to visit Torquay, by remarking that, although it was not unusual for Vice-Chancellors to go "up in the air," it was quite unique to have a Vice-Chancellor who went up in the air vertically and wore a top hat at the same time. He also announced that it was proposed to form a fighter control unit in the University, and ended by quoting a translation of Ovid referring to Cupid and Mars, and emphasizing the importance of youth in both fields—this, of course, was received with gales of laughter.

Mr. R. R. Shaw, an undergraduate of New College, said that Chipmunks had proved that one could fly without being physically uncomfortable. He was obviously expressing the views of Squadron members in stating that the future looked rosy for, with the formation of the control unit, the doors of the club would no doubt be thrown open to those fair undergraduates of St. Hugh's and Lady Margaret Hall. Mr. Shaw paid tribute to the flying instructors for the difficult job they had with pupils who flew only about once a week, and Mr. Acres said, "he is a man who ties the past and present of the Squadron to the future."

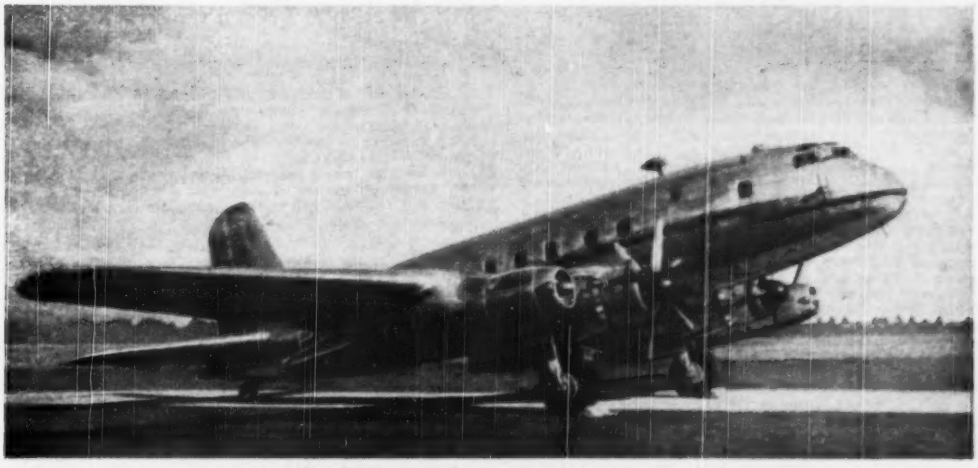
Mr. Acres congratulated the Squadron for a 100 per cent turnout for "ground training" that evening. This was rapturously received. The chief point which struck him about his 25 years of service was that the buildings and the undergraduates remained the same—only the equipment changed: when he first came to the Squadron the aircraft had rotary engines. The Squadron's war record was enviable; of the 300 Squadron members who had gone to war, 150 had received awards, including two V.Cs. There were eight ex-members of the Squadron in the present Parliament, and they had one High Commissioner as well. There was, of course, always the recurring problem of changes of commanding officers, but he thought he would include the present C.O. as one of the prize exhibits at his 50th anniversary.

NEW FLUID-LEVEL SWITCH

TO meet the need for a fluid-level switch incorporating both "make" and/or "break" contact facilities, Smith's Aircraft Instruments, Ltd., have newly developed an improved switch unit which can be fitted at the top, side or bottom of a tank. In conjunction with a warning lamp, or flag indicator, the switch can be used to indicate a predetermined level of fluid in a tank, and other applications which spring readily to mind are those of a refuelling cut-off switch, or a pump cut-off switch for "tank empty" conditions.

The switch weighs 15 oz, and is flange-mounted with 12 fixing holes to fit standard 4.25in bolt-rings. The mechanism consists of a hinged cork float, enclosed in a domed cover, the float being magnetically coupled through a sealing diaphragm to the contacts.

SOMETHING NEW at RADLETT: THE SAPPHIRE-HASTINGS



Piloted by S/L. H. G. Hazelden, Handley Page's chief test pilot, this Hastings, powered with Armstrong Siddeley Sapphire turbojets in place of the outboard Bristol Hercules piston engines, flew from Radlett airfield on November 13th. S/L. Hazelden reported that even when he throttled the Hercules back he was unable to hear the Sapphires. Though he used only half thrust on the initial flight, the climb-away with wheels down was extremely good, and the Hastings was at 1,000ft in approximately thirty seconds.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

All for £650 a Year

AS a "satisfied pupil" of one instructor, and therefore with no personal axe to grind, may I add my voice in wholehearted support of "Instructor's" letter (*Flight*, November 9th)?

There must be few occupations where remuneration has not been augmented to some degree, to take account of the fact that living costs are up by a factor of 2 to 3 since 1939. There can surely be no justification for assuming that the flying instructor, and his wife and family, are immune from these increased costs; and remuneration more in keeping with the times seems long overdue. From my own industrial experience, I know that there are many unskilled and semi-skilled labourers receiving more than £650 per year; and when one considers the long and complex training necessary to make a flying instructor, it seems a gross anomaly, and a reflection upon British aviation, that such a highly skilled man should receive less than a relatively unskilled one.

Apropos what the flying instructor does, I consider that "Instructor" understates the case. Many instructors also do duty with the clubs, where they must add to their flying and instructional skill a measure of tact and psychological appreciation to a high degree. Risk, also, is never absent from their day, even though aviation is passing from the romantic era to the safe stolidity of the saloon car. If, as at two airfields I have known, ground crew develop a quaint habit of disappearing when most wanted, the instructor may all but finish his day by sweating to hangar aircraft. To finish it—perhaps at 10 p.m.—he may be expected to spend a further lump of his £650 (minus deductions) in hospitality to club members, while he listens to their enthusiasms, difficulties, and wizard analyses, all based on ten hours' flying.

It seems to me, however, that quite apart from, or perhaps inextricably mingled with, any question of just reward, the gravest danger in continuance of the present salary levels lies in frustration of the voluntary spirit. The flying instructor, even paid, must at all times be such an enthusiast for his vocation that he discounts risk, hours, boredom, frustrations, disappointments, hard work, nerve strain and many other things. He voluntarily gives himself unstintingly to his pupils. To devaluate that voluntary sacrifice of self by inadequate remuneration is to invite the attitudes of "safeguarding rights," and of doing the minimum which "just gets by." This attitude is far too common in the nation to-day, and it will be a sorry day if ever it creeps insidiously into the flying instructors' ranks.

Stirlingshire. GRATEFUL PUPIL.
(Private Pilot's Licence 27069).

Air Safety

THE following observations on aspects of air safety arising out of recent crashes may be useful as a basis of discussion.

On the subject of displaced centres of gravity and the way the behaviour of an aircraft may be affected in such circumstances, the following personal experience may be relevant. When following in a Whitley to land at Dishforth one night in early 1941 I saw it crash in a manner sufficiently unexpected to make me take particular note for future reference—it cartwheeled in, due, it was said, to its c.g. having moved dangerously aft because it was returning with an unused bomb in its fuselage and empty fuel tanks. A few weeks later I was myself landing in a Whitley with empty wing tanks and a full overload fuel tank in the fuselage; on throttling back in the final approach, the nose of the aircraft reared up skywards and only the combined weight of the pilot and second pilot thrown forward on the control column brought it down again.

(2) The low survival rate in crashes is largely due, we know, to the lack of backward-facing seats, flexible fuel tanks, automatic fire extinguishers, and inertia-controlled cut-out fuel and ignition switches, while other causes which are probably no less responsible are the carriage of fuel in the fuselage, instead of only in the wings, and high landing speeds. Yet one wonders whether even with these hazards removed more passengers would not be saved, however inadequate the size and choice of escape exits, if they were briefed as thoroughly in emergency-escape drill as passengers have to be who travel by sea. In the Services there is an extensive scheme of internal and external rescue markings which civil operators ignore on the absurd score that it would frighten, instead of reassure, the passengers—the same reason they give for playing down briefings as much as possible. Yet even if some fare-paying passengers *were* put off flying because of additional precautions for their safety should not this responsibility be accepted for the sake of the others?

(3) The incidence of crashes could be cut down, one imagines, if there were more hard-and-fast limits as to the conditions in which civil airlines can operate. No aircraft should be flown with passengers beyond the safe limits of its capabilities; no aircraft should be allowed to take off unless a defined minimum of safe-landing conditions is within range at all points along its route. (These landing conditions should include clear visibility at least in the last stage of landing for a horizontal distance of 1,000 yards, at present landing speeds, and with a cloud base sufficiently high to allow a visual hold off.) In this respect there would be some variation according to the type and modernity of aircraft, the skill and experience of the captain, and whether or not the aircraft had a tricycle undercarriage—as well as the obvious variation governed by the landing facilities available at different airports and emergency landing fields. The latter, in particular, is, of course, of primary importance *and should not be left to the discretion of the pilot*, who should never be left in the invidious position of having to decide whether or not to call for the aid of expensive apparatus, such as FIDO, or to risk the lives of his passengers in order to save his company from the heavy fees which may be involved in making use of such facilities. These fees and expenses should be a charge on the community in exactly the same way as are lifeboat and lighthouse services.

(4) For feeder-line services, that is, where aircraft are used on relatively short runs and their entire internal space is made use of for seated passengers, as in omnibuses on roads, consideration might be given to reviving the old type of biplane construction, which allows, I believe, larger escape apertures without loss of strength, and slower landing speeds. Compared with time losses caused by embarkation, the slightly longer time taken on average point-to-point services would not be a very big factor, and in any case the chief saving in time on such routes is surely the fact that the journey is made as the crow flies. (It would be interesting to compare Imperial Airways' time schedules and safety record with those of the post-war era.)

Finally, whether or not it is practicable to use them, it cannot be disputed that while passengers are not provided with parachutes there will always be the chance of a wholesale write-off when civil aircraft find themselves in a position when they land or force-land in nil visibility, or are cruising at altitude when uncontrollable fire breaks out.

East Twickenham, Middlesex. D. G. HORNSEY.

The Airship "Bournemouth"

From Lord Ventry

THANK you for your article (November 16th) on our airship *Bournemouth*. To give honour where honour is due, however, I feel it should be made clear that Mr. A. C. Leith has practically built the car himself, and with S/L. T. P. York-Moore did most of the detail designing of the ship.

S/L. York-Moore has been one of the most hard-working of the little team concerned with this airship since the start. He will, we hope, either be pilot, or at any rate second pilot, of the airship on its trial flights. His past experience as a Captain of S.S. Coastal and C Star airships has been invaluable.

Bournemouth, Hants. VENTRY.

Output and Airscrew

I FEAR it is a little late to be commenting on your issue dated September 21st, but details of the Pratt and Whitney T.34 Turboprop give rise to certain questions. Firstly, if this engine develops 5,700 h.p. how come that a single four-blade prop can absorb such power? Is it, perhaps, that the prop absorbs some 3,500 h.p. and the remainder is released as exhaust efflux? Secondly, to develop such power from a 13-stage axial compressor of a diameter no greater than 30in is an achievement about which I think we should hear more.

Glasgow, W.2. J. R. PLENDERLEITH.

[Though the figures quoted in our paragraph were as supplied by the makers we agree that the point raised is worthy of clarification. P. and W. further state that 5,700 h.p. is the rated figure for a 50-hour test, that the proportion of power delivered to the airscrew shaft is 90 per cent, and that units have considerably exceeded the power figure quoted.—ED.]

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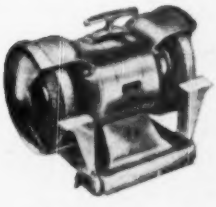

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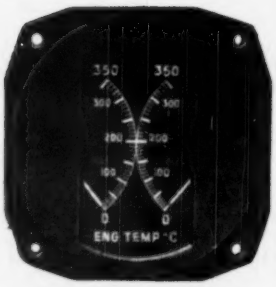

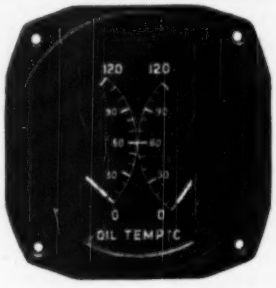

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Below : Model 5127. Dual Ratiometer Indicator, comprising two 100° Ratiometer movements housed in large-size S.A.E. case. For use in conjunction with thermometer bulbs, electrical oil pressure transmitters, electrical position indicators or any combination of two of these to indicate a variety of temperatures, pressures or position.

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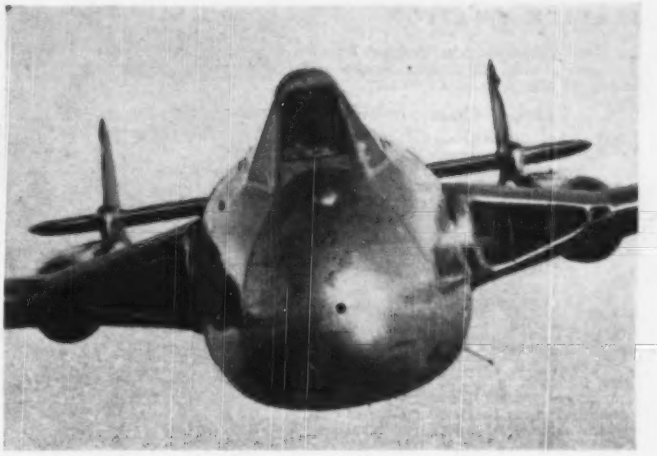


STERN APPROACH: A tail-gunner's intimate view of the Ghost-powered D.H. Venom, which is now in production for Fighter Command.

Royal Visits

PRINCESS ELIZABETH visited Fighter Command Headquarters, Stanmore, last Friday and watched, in the underground control room, the plotting of a "raid" on the English coast. She also saw displays of individual and formation aerobatics by jet fighters. On the previous day H.R.H. the Duchess of Gloucester inspected Technical Training Command H.Q. at Brampton and the R.A.F. and U.S.A.F. bomber-base at Wyton.

Coastal Command Appointments

AIR COMMODORE A. F. HUTTON, C.B.E., D.F.C., Director of Servicing and Repair at the Air Ministry since March, 1949, will become Senior Technical Staff Officer at Headquarters, Coastal Command, on November 27th. Before going to the Air Ministry, Air Commodore Hutton was Senior Technical Staff Officer, Air Command, Far East (now Far East Air Force), where he went in June, 1946, after having been Senior Air Staff Officer, No. 43 Group, Maintenance Command, for about nine months. He was previously Deputy Air Officer in Charge of Administration at the headquarters of "Tiger Force," which was to have gone into action against Japan.

Sir Thomas Elmhirst Honoured

THE Government of India have appointed Air Marshal Sir Thomas Elmhirst, K.B.E., C.B., A.F.C., R.A.F. (Retired), to a commission in the Indian Air Force, in the honorary rank of air marshal with effect from October 16th, 1950, in recognition of his valuable services to the Indian Air Force, which he commanded from August 16th, 1947, to February 22nd, 1950. Air Marshal Elmhirst retired from the R.A.F. on June 29th.

Hastings for Weather Squadron

HANDLEY PAGE Hastings are now replacing Halifaxes in the R.A.F. meteorological squadron at Aldergrove, Northern Ireland. Aircraft from this unit, which belongs to Coastal Command, make daily flights of 1,600 miles over the Atlantic to obtain information on cloud formation, temperature, pressure and humidity.

The Hastings are outwardly similar to the type used by Transport Command, but they have been modified internally and equipped with a comprehensive range of meteorological instruments. The more spacious layout and increased amenities of the new aircraft will enable the meteorological air observers to work more accurately and with greater efficiency, and its higher performance will eventually permit observations to be made over a wider range of distance and height.

The meteorological air observer sits in the front of the aircraft beside the pilot and has a clear and unrestricted view. There is a second observer's position in the rear of the fuselage. Two stretcher beds are fitted, on which crew members may rest when off duty. There are facilities for providing hot meals, and the capacious cabin enables the crew to move about the aircraft easily. Meteorological equipment carried includes a psychrometer (to determine air temperature and humidity), a frost point hygrometer (to record humidity at very low temperatures), a high-level radio altimeter, aneroid, drift sight indicator and smoke and flame float tubes. There is also a hand camera, for cloud photography. In addition the aircraft carries equipment for air-sea rescue operations as well as comprehensive navigational aids.

At regular intervals throughout each flight, the information obtained is transmitted by radio in international meteorological code so that it may be immediately available to the forecaster at the Central Meteorological Office, Dunstable, and also for world-wide radio distribution.

Canuck in the States

A PROTOTYPE Avro Canada Canuck all-weather fighter recently flew to Wright Field, Dayton, Ohio, for a courtesy visit to the U.S.A.F. Staff officers of the Air Materiel Command were to be "checked out" on the Canuck by its pilot, S/L. E. L. Badoux, D.S.O., D.F.C., a test pilot at the R.C.A.F. Experimental Proving Establishment, Rockcliffe.

It was recently suggested that the U.S.A.F. might adopt the Canuck as a standard all-weather fighter, although the Northrop Scorpion has already been selected for this role. Even if the suggestion is not followed up, the U.S.A.F. is likely to watch development of the Canuck as both the aircraft and the turbo-

INSTRUMENT EXPERTS: Pictured at Horsham St. Faith during a recent exercise are the pilots of No. 74 Squadron (Meteor 8s), which holds the Duncan Trophy, awarded last September, for proficiency in all-weather flying.

SERVICE AVIATION . . .

jets (Avro Canada Orendas) designed for it are near at hand and available for production on a larger scale if necessary.

R.A.F. Fencing Championships

ROYAL Air Force fencing championship competitions, organized by the R.A.F. Fencing Union, will be held at R.A.F. Station, Cosford, as follows:—Inter-unit senior and junior team Championships, December 11th-14th; R.A.F. junior championship-at-arms, for the Birch Shield, January 22nd-24th; W.R.A.F. junior championship, January 24th.

African Flight Anniversary

TWENTY-FIVE years ago—on November 19th, 1925—three D.H. 9As of the R.A.F. landed at Helwan, near Cairo, having completed the first return flight across Central Africa to Nigeria. They left Helwan on October 27th, and on their return, had covered a distance of about 6,500 miles in 85 flying hours. This flight pioneered the route which was subsequently developed by Imperial Airways and during the war became a vital supply route over which more than 5,000 aircraft were flown to equip and reinforce operational squadrons.

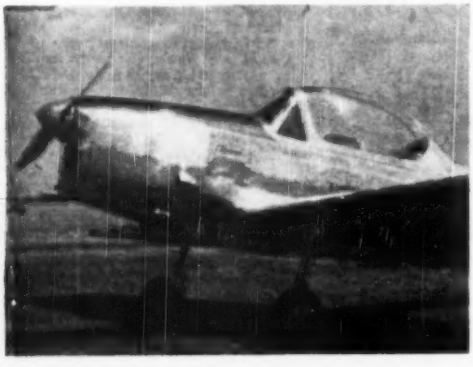
Led by the late Air Marshal Sir Arthur Coningham (then a squadron leader) the "Nine Acks" flew to Kano via Wadi Halfa, Khartoum, El Fasher and Fort Lamy, with other intermediate stops. Their cruising speed was 75 m.p.h. At Kano, now one of the main aerial crossroads of Africa, a huge crowd of Africans gathered to see them arrive. There was some delay due to carburettor trouble at the previous stop and, in the words of S/L. Coningham's report, "the great majority of the people were doubters, and went away convinced that the white man was simply telling a tale." Despite this, a crowd estimated at 20,000-30,000 remained. The following morning, when local dignitaries were given short flights, even larger crowds were present, and there was a big murmur as the aircraft took off. The flight was completed without any engine trouble of consequence, the main difficulty being frequent tyre punctures caused by thorns on the rough desert and bush airfields.

C.S.O. Fighter Command

GROUP CAPTAIN MICHAEL WATSON, C.B.E., who has been Deputy Chief Signals Officer at Headquarters, Fighter Command, since April last, is to become Chief Signals Officer of the Command, with the acting rank of air commodore, in December, in place of A.Cdre. V. G. A. Hatcher, O.B.E., A.F.C., who will take up the appointment of Director of Signals (Organization) at the Air Ministry in January. During the war G/C. Watson held a variety of signals posts, culminating in an appointment to Headquarters of the Allied Expeditionary Air Force on its formation in 1943. After the war he was Chief Signals Officer, No. 216 Group, in the Middle East, and later went to Headquarters, Mediteranean and Middle East Command (now Middle East Air Force). In August, 1947, after spending the earlier part of that year on a course at the Joint Services Staff College, he was appointed Deputy Director of Signals at the Air Ministry. In March, 1949, he was given command of the Southern Signals Area, where he remained until he went to Fighter Command.

At the outbreak of the war A.Cdre. Hatcher was on signals duties at Headquarters, No. 11 (Fighter) Group, going from there to Fighter Command in 1941. From 1943 to 1945 he was Chief Signals Officer at Headquarters, Coastal Command, and afterwards at Headquarters, British Air Forces of Occupation, Germany, until October, 1947. On his return to the United Kingdom he became Senior Air Staff Officer of No. 90 (Signals) Group, where he remained until he went to Fighter Command two years ago.

UNIFICATION: These cadets, of five North Atlantic Treaty nations, are receiving basic flying training in Harvards of the R.C.A.F. at Centralia, Ontario. Left to right are: Lt. Wang (Norway), 2/Lt. Maes (Belgium), Cdt. Ronaasen (Canada), 2/Lt. Quarantelli (Italy), and Cdt. Van der Vlugt (Holland). No replacement for Canada's Harvards has yet been announced.



TRANSATLANTIC STYLE: The one-piece clear-vision canopy of this Chipmunk is now standard on all Canadian-built examples of this de Havilland trainer. British production-versions may eventually follow suit. By this innovation a first-class trainer is further improved.

Staff College Visit

A PARTY of students from the R.A.F. Staff College, Andover, has just completed a week's visit to the British Air Forces of Occupation, Germany. Led by the Commandant A.Cdre. J. N. T. Stephenson, the party included R.A.F. officers and those from the air forces of 13 other countries—Belgium, Egypt, Eire, France, Greece, India, Italy, Norway, Pakistan, Portugal, Sweden, U.S.A. and Venezuela.

W.R.A.F. Commissions in Fighter Control Branch

WOMEN candidates are now eligible for short-service commissions in the Fighter Control Branch of the R.A.F. This branch is the medium through which all the active and passive defences of the country are alerted, set in motion and co-ordinated. With this responsibility, its ultimate function is the control of fighter aircraft.

Candidates must have attained the age of 18½ years and have been educated at least to School Certificate standard.

Those selected will enlist as airwomen and will be commissioned after ten months' training; those successful will be appointed initially in the rank of pilot officer to short service commissions for five years' regular and four years' reserve service and will be eligible for extension of service and for consideration for permanent commissions. Subject to satisfactory service and passing promotion examinations, promotion to flying officer will take place after two years as pilot officer, and to flight officer after about six years.

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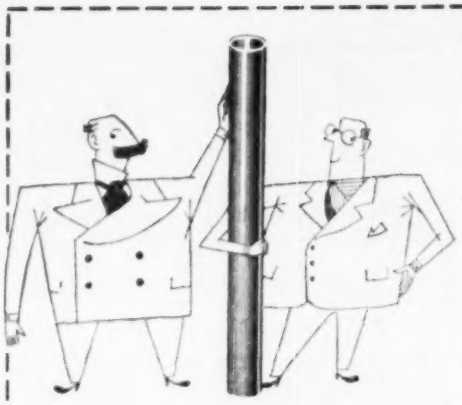

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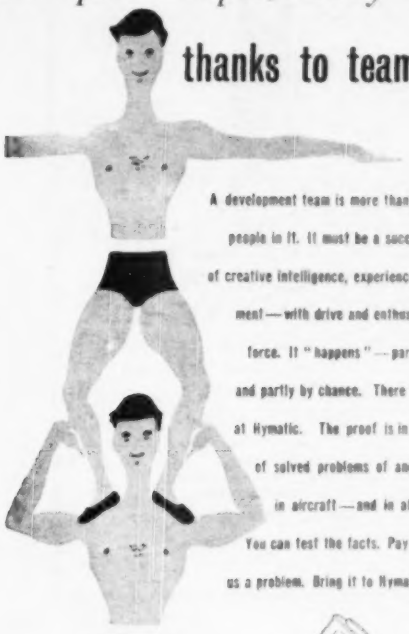

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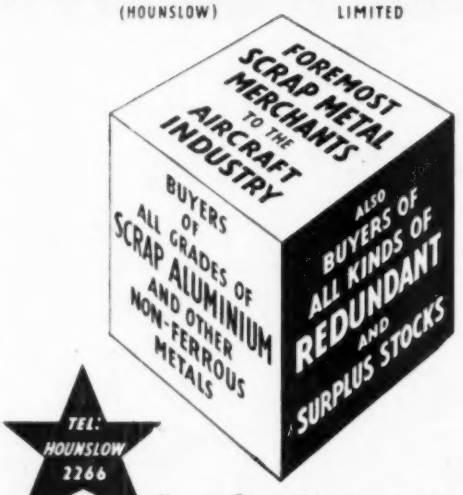
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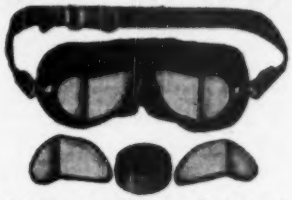

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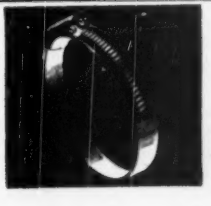

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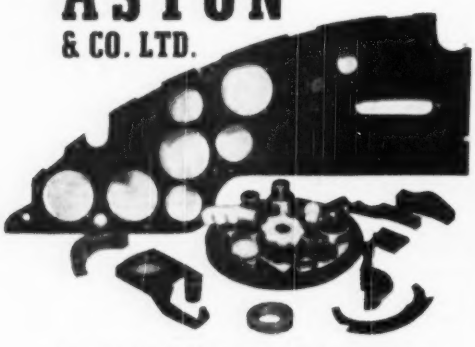

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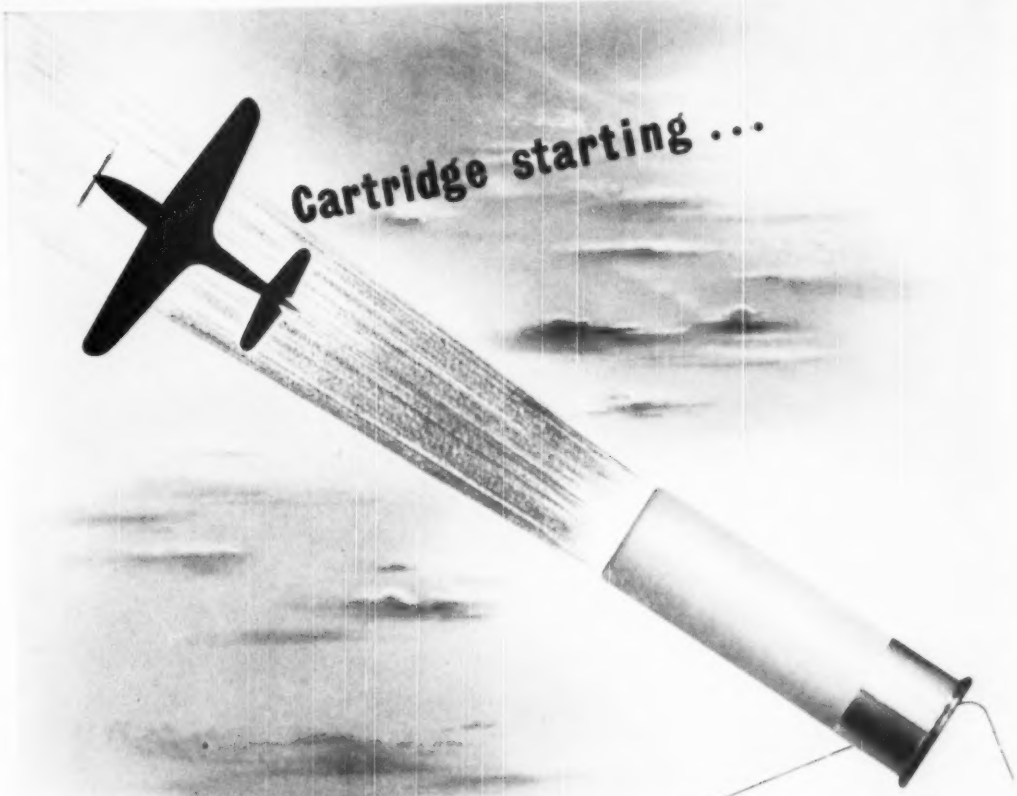

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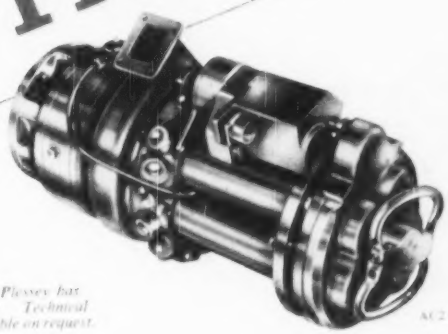

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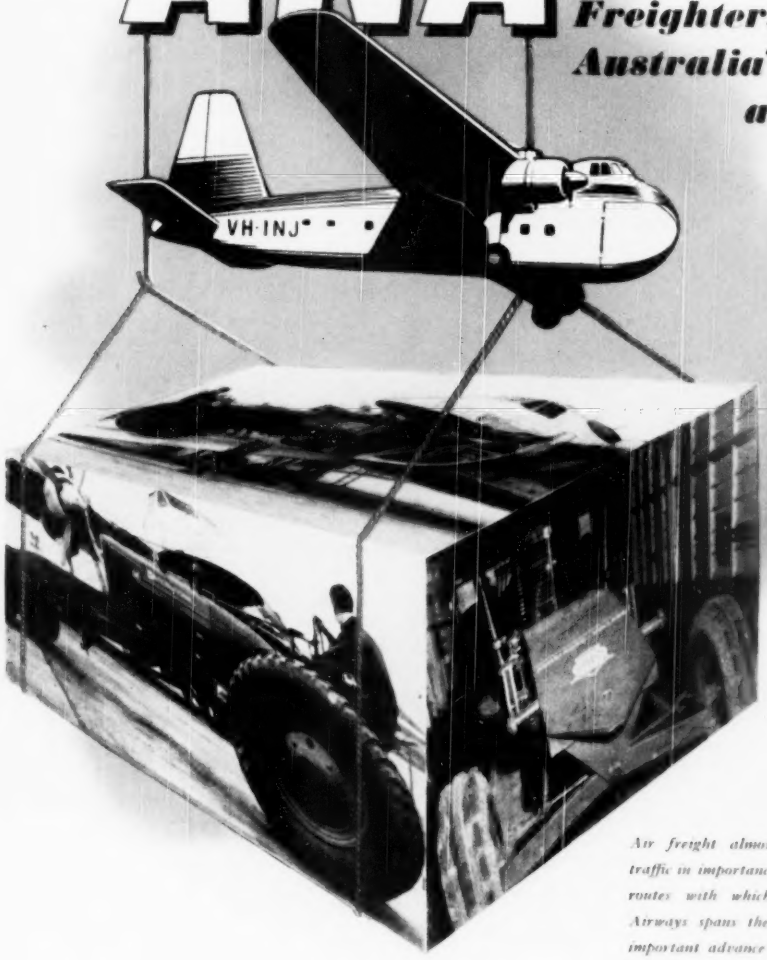

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